THE PENNATULACEA OF SOUTHERN AFRICA (COELENTERATA, ANTHOZOA)

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(With 41 figures)

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ABSTRACT

Nineteen species of pennatulacean octocorals from sublittoral and bathyal regions of southern African coastal waters are described and illustrated. Six additional species that are recorded in the literature are mentioned, although material was not available for examination. Two of these, *Cavernulina cylindrica* and *Virgularia juncea*, are considered dubious records and are not included in the faunal list provided for the region. Presumably young or partial colonies or problematic taxa representing seven genera (*Cavernulina*, *Kophobelemnon*, *Scleroptilum*, *Calibelemnon*, *Virgularia*, *Halipteris*, and *Pteroeides*) are not identified to species but are mentioned in the text and included in the list of species. A total of 23 determined and at least seven undetermined species representing 20 genera in 12 families are recorded. Three species that have been recorded from Angola, which is north of the geographic limit of this paper, are also mentioned: *Virgularia tuberculata*, *Pteroeides griseum*, and *Crassophyllum cristatum*; these may possibly be encountered further south.

Fourteen new geographic records are established, including the first southern African records for the following ten genera: *Cavernulina*, *Echinoptilum*, *Kophobelemnon*, *Distichoptilum*, *Scleroptilum*, *Calibelemnon*, *Chunella*, *Amphiacme*, *Scytaliopsis*, and *Halipteris*.

Scanning electron micrographs of sclerite form or axial morphology are presented for many species. A key is provided to all species treated in the present work. A brief discussion of faunistic considerations is also included.

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INTRODUCTION

At present, octocoral classification is frequently an equivocal and disputatious field (Weinberg 1976: 63). It is clear that our knowledge concerning this group is far from adequate; a great deal of research needs to be accomplished in order to attain the goal of a world-wide synthesis of the biology and classification of octocorals (Bayer 1981*a*: 11). A substantial amount of confusion has arisen in the literature because of a general lack of knowledge concerning variability; some octocoral species can be exceedingly variable and many authors have described species or even genera based on intraspecific variants. Extensive collecting in many different geographical localities and detailed comparison of material is needed to assess the degree of variation in many taxa due to genetic, geographical, or ecological differences.

The goal of the present study of the systematics and faunistics is to contribute toward a world-wide synthesis of the classification and distribution of octocorals by concentrating on a localized fauna that has been previously only minimally to moderately known. This work is the first of four proposed parts describing the octocorals of southern Africa. Subsequent papers will deal with additional species of pennatulaceans from the Cape, Transkei and Zululand; stoloniferous octocorals and soft corals (families Clavulariidae, Tubiporidae, Coelogorgiidae, Alcyoniidae, and Nephtheidae); and the shallow-water gorgonians (families Anthothelidae, Melithaeidae, Keroeididae, Acanthogorgiidae, Plexauridae, Gorgoniidae, Ellisellidae, Chrysogorgiidae, Primnoidae, and Isididae). The four papers together will attempt to synthesize our knowledge of southern African octocorals. The studies exclude the deep-water gorgonians, primarily of the families Ellisellidae, Primnoidae, and Chrysogorgiidae, groups that are less well known regionally or that require large-scale revisions before accurate identifications can be made. Many octocoral species that have been collected still need to be identified and new species are continually being discovered.

The present work is intended not only for specialists in the field of octocoral systematics but also as a guide for other biologists, e.g. ecologists, fisheries biologists and biogeographers, who share the common need to identify material from benthic surveys and other studies. Southern African octocorals are of interest to non-specialists, since they comprise such a major part of the shallow-water benthic fauna. Therefore, sections have been added to the texts of these papers that would not normally be included in a work intended solely for specialists. These include brief diagnoses of the families and genera, sections on general characteristics of the octocoral groups, and illustrations of the entire colonies of all species, as well as figures depicting diagnostic features, sclerites, and other features.

The monograph by Kükenthal (1915) remains the most comprehensive work on pennatulaceans of the world and is certainly the most thorough account up to that time. Modern revisions of many of the genera are obviously needed. Other major reviews on sea pens are mainly monographs produced from the large oceanographic expeditions of the past and include Kölliker (1872*a*, 1872*b*), Kölliker (1880) (Challenger), Danielssen & Koren (1884) (Norwegian North Atlantic), Kükenthal & Broch (1911) (Valdivia), Hickson (1916) (Siboga), and Broch (1958*b*) (Discovery). Thomson (1915, 1917) described the pennatulacean fauna of South Africa known at that time and Bayer (1956) reviewed the known world genera. Tixier-Durivault (1954, 1960, 1961*a*, 1966*b*, 1972) and Tixier-Durivault & D'Hondt (1974) described material from South Africa, Mozambique, Angola, and Madagascar (including neighbouring islands). General accounts of the biology of sea pens are by Hickson (1909) and Hyman (1940). More recently, the distribution and taxonomy of pennatulaceans has been reported on by Pasternak (1960, 1961*a*, 1961*b*, 1962, 1964, 1970, 1975*a*, 1975*b*, 1980), Grasshoff (1972, 1981, 1982*a*, 1982*b*), and D'Hondt (1984*a*, 1984*b*).

Bayer (1981*a*: 7) classified various geographic regions of the world into four general categories of taxonomic knowledge pertaining to octocorals: essentially complete; moderately well known; poorly known; and minimally known. He considered South Africa, in the region of the Cape of Good Hope, to be moderately well known and described this category as follows: 'where there is extensive literature, but many more species remain to be described and taxonomic problems to be solved, and the major patterns of distribution must yet be worked out. Much descriptive work remains to be done before ecological and experimental studies can proceed at an effective level'. The rest of southern Africa is less well known and certain regions fall into Bayer's latter categories—being poorly or even minimally known. Two such regions include the Atlantic coast between 20°S and 33°S, and the northern Natal–southern Mozambique region of the Indian Ocean between 20°S and 29°S.

Southern Africa is here defined as the African coastal region that lies south of 20°S—an arbitrary limit used by Millard (1978) in a zoogeographical analysis of southern African hydroids, which are another diverse and widespread benthic group. This region extends from the Skeleton Coast of Namibia in the Atlantic, round the coast to the vicinity of Beira, Mozambique, in the Indian Ocean. Material examined in the present work was obtained throughout this range from the continental shelf, slope and rise, and from the littoral to depths of 3 000 m.

The island of Madagascar is not included here, since its affinities are strictly Indo-Pacific and not directly associated with the southern African fauna.

Pennatulaceans from geographical regions marginal or in proximity to the area of the present study have been described by Broch (1958*b*) and Tixier-Durivault (1961*a*, 1963) for Angola, and Tixier-Durivualt (1966*b*, 1972) and Tixier-Durivault & D'Hondt (1974) for Madagascar.

Of the 14 presently recognized pennatulacean families of the world, 12 (or 86 %) are represented in southern Africa, and of the 34 world genera, at least 20 (or 59 %) are known from this region. The only families not represented in the regional fauna are two monogeneric ones: the Renillidae—genus *Renilla* Lamarck, 1816, with four or five species restricted to South America and the southern part of North America; and the Stachyptilidae—genus *Stachyptilum* Kölliker, 1880, with three species presumably restricted to warmer parts of the Pacific Ocean.

The classification system used in this study at the subordinal and familial levels conforms to Kükenthal (1915) and Bayer (1956). Terminology conforms to the trilingual glossary of Bayer *et al.* (1983). All illustrations, photographs, and scanning electron micrographs are by the author. The abbreviation 'Lit.!' in a synonymy indicates where a complete or more detailed synonymy can be found. The notation *non* in the synonymies indicates a misidentification by the author cited; *partim* indicates 'in part'.

Characteristics of the Pennatulacea

The pennatulaceans, or sea pens, are considered a very distinct and greatly specialized group of octocorallian cnidarians (Hickson 1909: 358; 1930*b*: 229; Bayer 1956: 181). Unlike other octocorals, pennatulacean colonies are formed by a very large polyp, the oozooid (also known as the axial, initial, principal, or primary polyp), that by lateral budding of its body walls gives rise to all the secondary zooids of the colony. The oozooid forms a fleshy, unbranched peduncle to anchor the colony by peristaltic contractions in soft substrata such as mud, sand, or abyssal-ooze deposits. The polyps of an individual colony (excluding the oozooid) are always dimorphic, more rarely trimorphic; the distal region of the oozooid forms a rachis bearing several to many daughter polyps, which take the form of autozooids, siphonozooids, and sometimes mesozooids. Disregarding the oozooid. the autozooids (Fig. 11E) are the largest polyps in polymorphic colonies and possess eight well-developed tentacles and mesenteries; these are the feeding polyps of the colony. Siphonozooids (Fig. 11C) are much smaller than autozooids and have strongly developed siphonoglyphs that produce currents for internal water circulation; the tentacles are reduced or absent. Mesozooids (Fig. 32B, D) are polyps that are intermediate in structure between autozooids and siphonozooids.

In colonies with bilateral symmetry and well-developed polyp leaves (such as *Virgularia*, *Pennatula*, and *Pteroeides*), the dorsal side refers to the side of the rachis adjacent to the oldest (usually largest) autozooids, where the rachis appears mostly bare and uncovered by the polyp leaves; hence, the ventral side refers to the side of the rachis opposite to the dorsal side, where the polyp leaves cover most or all of the rachis surface.

Characteristics that are important in the classification of pennatulaceans include the form, number, and arrangement of autozooids; distribution of siphonozooids; the colonial symmetry, growth form, and axial development; and form and distribution of sclerites. Pennatulacean sclerites differ from those of other octocorals by commonly being smooth and unsculptured, sometimes grooved or three-flanged, with tubercles usually absent but, if present, then simply knobby or rounded, not thorny or elaborate.

MATERIALS AND METHODS

Recently procured material was collected by means of SCUBA, dredge, or beam trawl. Colonies were relaxed in a solution of magnesium chloride mixed with sea-water and preserved in 70 per cent ethanol. Small and fragile specimens were first fixed in 10 per cent formalin before transfer to ethanol. Sclerites and axial fragments were isolated by dissolving tissue in concentrated sodium hypochlorite, with repeated rinsing in water and finally in ethanol. Minute sclerites were pipetted from alcohol suspension and dropped on to stubs that had circular pieces of exposed and developed black-and-white photographic paper glued to them. After evaporation of the alcohol, the sclerites adhered well to the paper surface. Large sclerites and fragments of axial material were applied directly to the stub surface with SEM glue. Specimens were coated with gold/palladium (Au/Pd). Cambridge S200 and S180 scanning electron microscopes were used to examine sclerites and axial fragments.

All material examined is housed in the marine invertebrate collection of the South African Museum (SAM), Cape Town.

SYSTEMATIC ACCOUNT

KEY TO THE FAMILIES OF PENNATULACEA FROM SOUTHERN AFRICA

1A. Adjacent polyps free, not fused to any degree...................... 2
1B. Proximal portions of adjacent polyps fused to some degree, forming polyp leaves or raised ridges, or joined only at the bases.................. 9
2A. Polyps crowded and distributed on all sides of rachis, or rachis with a single longitudinal furrow or V-shaped region without polyps 3
2B. Polyps confined to a terminal cluster, arranged biserially along rachis, or in groups of two to four arranged sparsely along rachis 4
3A. Polyps without calyces................................ **Veretillidae**
3B. Polyps with non-retractile bifurcated calyces .... **Echinoptilidae**
4A. Polyps arranged in a terminal cluster at the end of a long slender stalk .... **Umbellulidae**
4B. Polyps arranged along the sides of the rachis...................... 5
5A. Colonies clavate, distal portion of rachis distinctly wider than rest of colony .... **Kophobelemnidae**
5B. Colonies not clavate, but are long, thin and whip-like or staff-like..... 6

6A. Polyps numerous (>40) and contiguous, arranged in two longitudinal series along rachis. Sclerites dense. Polyps retractile into calyces............ 8

6B. Polyps few (<40), arranged sparsely in clusters of 2–4 at intervals along rachis. Calyces and sclerites not apparent.......................... 7

7A. Polyp pairs 10–20. Intervals between polyp pairs <10 mm .. **Scleroptilidae**

7B. Polyp clusters <5. Intervals between clusters of 1–4 polyps is >20 mm .... **Chunellidae**

8A. Calyx with eight terminal teeth .... **Funiculinidae**

8B. Calyx with 0–6 terminal teeth.......................... **Protoptilidae**

9A. Polyps non-retractile, calyces absent. Adjacent polyps united at their bases only, not forming polyp leaves or raised ridges........... **Anthoptilidae**

9B. Polyps retractile into calyces or into margins of fleshy polyp leaves or raised ridges 10

10A. Polyps have tubular calyces with eight terminal teeth ...... **Pennatulidae**

10B. Polyps have calyces with two terminal teeth, or calyces absent 11

11A. Polyp leaves stiffened with large white needle-like sclerites up to 10 mm that form projecting supporting rays .... **Pteroeididae**

11B. Polyp leaves soft without sclerites, or polyps arranged in raised ridges with calyces having two terminal teeth .... **Virgulariidae**

KEY TO THE SPECIES OF PENNATULACEA FROM SOUTHERN AFRICA

1A. Adjacent polyps free, not united to any degree. Individual polyps arise directly from the surface of the rachis (e.g. Fig. 11A) 2

1B. Proximal portions of adjacent polyps fused to some degree, often forming flattened expansions (polyp leaves, e.g. Fig. 32A, D), raised ridges or swellings that emanate laterally from the rachis (e.g. Fig. 30B, D), or joined only at their bases with major portions of polyps free (e.g. Fig. 17B) 20

2A. Polyps crowded and distributed evenly on all sides of rachis, or rachis with a single longitudinal furrow or elongate V-shaped region devoid of polyps. Colony radially symmetrical or somewhat bilaterally symmetrical, capitate, clavate, or digitiform 3

2B. Polyps restricted to a limited portion of rachis, arranged biserially along rachis, or concentrated in a terminal cluster, or in groups of two to four distributed sparsely along rachis 11

3A. Polyps without calyces 4

3B. Polyps with non-retractile bifurcated calyces 9

4A. Sclerites are smooth ovals, rods that are bilobed or branched at the ends, or spindles up to 0,4 mm in length. Colonies clavate or capitate 5

4B. Sclerites are small flat plates (<0,1 mm in length) medially constricted with rounded ends or with terminal denticles. Colonies cylindrical to elongate clavate 7

5A. Rachis sclerites are primarily rods with bilobed or branched ends .... *Cavernulina* sp.

5B. Rachis sclerites are ovals or spindles that are usually not bilobed or branched 6

6A. Internal axis absent. Sclerites are mostly spindles... *Cavernularia elegans*

6B. Internal axis present. Sclerites are mostly ovals....... *Cavernularia dayi*

7A. Colonies elongate clavate. Sclerites are small biscuit-shaped plates, many with terminal denticles .... *Lituaria valenciennesi*

7B. Colonies cylindrical or elongate clavate. Sclerites are flat plates with medial constrictions and smooth, rounded ends 8

8A. Colonies plump and cylindrical with stalk shorter than rachis. Siphonozooids aligned in longitudinal rows. Colour yellowish to orange-yellow .... *Veretillum cynomorium*

8B. Colonies long and narrow, clavate, with stalk equal to or longer than rachis. Siphonozooids not aligned in longitudinal rows. Colour cream to greyish-white .... *Veretillum leloupi*

9A. Colonies radially symmetrical; polyps evenly distributed and covering all sides of rachis. Calyces often not conspicuous with unaided vision. Colonies usually straight or sometimes curved............... *Actinoptilum molle*

9B. Colonies bilaterally symmetrical; rachis curved, concave side with longitudinal furrow or V-shaped region near base of rachis free of polyps. Calyces conspicuous giving colony a spiny appearance 10

10A. Calyx length approximately three times the width. Calyx teeth long and thin, lanceolate. Peduncle sclerites are small ovals 0,04–0,15 mm in length. Colour of rachis often brick-red or deep reddish-purple .... *Echinoptilum echinatum*

10B. Calyx length approximately twice the width. Calyx teeth conical or deltoid. Peduncle sclerites are rods or spindles 0,07–0,47 mm in length. Colour of rachis orange to reddish-brown .... *Echinoptilum macintoshii*

11A. Polyps arranged in a terminal cluster at the distal end of a long naked peduncle 12

11B. Polyps arranged along the sides of the rachis.................... 13

12A. Polyps and distal portion of stalk with sclerites ..... *Umbellula thomsoni*

12B. Colony lacking sclerites altogether .... *Umbellula lindahli*

13A. Colonies clavate, distal portion of rachis wider than rest of colony; terminal end obtuse. Polyps large (>10 mm), non-retractile, without calyces .. 14

13B. Colonies not clavate, but are long, thin and uniform. Distal portion of rachis not wider than rest of colony 15

14A. Polyps 2 or 3 near terminal end of rachis .... *Kophobelemnon* sp.

14B. Polyps numerous and arranged biserially along rachis .... *Kophobelemnon stelliferum*

15A. Polyps numerous (usually >40) and contiguous, arranged along rachis in two longitudinal series. Polyps retractile into distinct calyces......... 16

15B. Polyps few (<40), arranged sparsely in clusters or whorls of 2–4 at intervals along rachis. Calyces absent................................ 18

16A. Calyx with 2–8 terminal teeth 17

16B. Calyx without terminal teeth . . . . *Scleroptilum* sp.

17A. Calyx with eight terminal teeth . . . . *Funiculina quadrangularis*

17B. Calyx usually with 2–6 terminal teeth. . . . . *Distichoptilum gracile*

18A. Polyps number 20–40, generally arranged in 10–20 pairs with 5–7 mm intervals of bare rachis between each pair. Colonies very delicate, usually <120 mm in length . . . . *Calibelemnon* sp.

18B. Polyps fewer than 15. Generally <7 polyp clusters per colony with intervals between clusters >20 mm. Mature colonies >120 mm in length. 19

19A. Polyps of rachis arranged in pairs. Distal end of colony with a single, well-developed, somewhat asymmetrical terminal polyp. . . . . *Amphiacme abyssorum*

19B. Polyps of rachis in clusters of one to four, but usually three. Distal end of colony with terminal polyp highly reduced or absent . . *Chunella gracillima*

20A. Polyps non-retractile, without calyces. Sclerites not evident. Adjacent polyps united at their bases only, major portion of polyps are free . . . . *Anthoptilum grandiflorum*

20B. Polyps retractile into conspicuous calyces or into margins of fleshy polyp leaves. Fused proximal portions of adjacent polyps form prominent polyp leaves, ridges, or basal swellings which emanate laterally from rachis in two longitudinal series 21

21A. Polyps arranged in short oblique rows of four to six polyps in two longitudinal series. Adjacent polyps united at their bases only, often forming a common raised ridge or basal swelling. Polyps possess calyces that each have two terminal teeth . . . . *Halipterus africana*

21B. Adjacent polyps united most of their length to form distinct and flattened lateral expansions (polyp leaves) that emanate from the rachis 22

22A. Colonies lack visible sclerites (sclerites too small to be seen with unaided eye). Peduncles usually thin and flexible or limp and worm-like 23

22B. Colonies with numerous and conspicuous sclerites (sclerites easily seen with unaided eye). Peduncles thick and rigid 26

23A. Polyps usually 5–12 per leaf. Polyp leaves sparsely arranged, with conspicuous intervals of bare rachis between leaves 24

23B. Polyps >12 per leaf. Polyp leaves densely situated, often overlapping one another with little or no interval of bare rachis between leaves. 25

24A. Polyps never more than five per leaf. Peduncle somewhat stiff. Adjacent polyps of a particular leaf gradually become larger from the innermost to the outermost polyp. Gradual transition between peduncle and rachis . . . . *Scytaliopsis djiboutiensis*

24B. Polyps 5–12 per leaf. Peduncle long and thin, vermiform. All polyps of a given leaf approximately same size. Peduncle and rachis abruptly delimited . . . . *Virgularia mirabilis*

25A. Polyps 50–200 per leaf . . . . *Virgularia gustaviana*

25B. Polyps 15–35 per leaf . . . . *Virgularia schultzei*

26A. Polyps possess tubular calyces with eight terminal teeth and dense sclerites of three-flanged spindles. Sclerites usually orange in colour. . . . . *Pennatula inflata*

26B. Polyps retract directly into outer margin of polyp leaf. Sclerites of polyp leaves are white or transparent spine-like needles up to 10 mm in length that align to form projecting supporting rays. Sclerites not three-flanged. Colour of colonies pale yellowish-grey or brownish-grey . . . . . *Pteroeides isosceles*

LIST OF THE PENNATULACEA RECORDED FROM SOUTHERN AFRICA

Order PENNATULACEA Verrill, 1865

Suborder SESSILIFLORAE Kükenthal, 1915

Family **Veretillidae**

* *Lituaria valenciennesi* D'Hondt, 1984
Cavernulina sp.
* *Veretillum cynomorum* (Pallas, 1766)
* *Veretillum leloupi* Tixier-Durivault, 1960
Cavernularia dayi Tixier-Durivault, 1954
Cavernularia elegans (Herklots, 1858)

Family **Echinoptilidae**

Echinoptilum macintoshii Hubrecht, 1885
Echinoptilum echinatum (Kükenthal, 1910)
Actinoptilum molle (Kükenthal, 1910)

Family **Kophobelemnidae**

Kophobelemnon stelliferum (Müller, 1776)
Kophobelemnon sp.

Family **Anthoptilidae**

Anthoptilum grandiflorum (Verrill, 1879)

Family **Funiculinidae**

* *Funiculina quadrangularis* (Pallas, 1766)

Family **Protoptilidae**

Distichoptilum gracile Verrill, 1882

Family **Scleroptilidae**

Scleroptilum sp.
Calibelemnon sp.

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* Literature records only; material not available for examination.

Family **Chunellidae**

Chunella gracillima Kükenthal, 1902
Amphiacme abyssorum (Kükenthal, 1902)

Family **Umbellulidae**

Umbellula thomsoni Kölliker, 1874
Umbellula lindahli Kölliker, 1874

Suborder SUBSELLIFLORAE Kükenthal, 1915

Family **Virgulariidae**

Subfamily Virgulariinae

Virgularia schultzei Kükenthal, 1910
Virgularia mirabilis (Müller, 1776)
Virgularia gustaviana (Herklots, 1863)
Virgularia sp.
Scytaliopsis djiboutiensis Gravier, 1906

Subfamily Balticininae

Halipteris africana (Studer, 1879)
Halipteris spp.

Family **Pennatulidae**

Pennatula inflata Kükenthal, 1910

Family **Pteroeididae**

Pteroeides isosceles Thomson, 1915
Pteroeides spp.

DESCRIPTIONS

Family **Veretillidae** Herklots, 1858

Colonies radially symmetrical without a trace of external bilateral symmetry. Colony cylindrical, clavate (club-shaped), or capitate (forming a head). Autozooids without calyces, completely retractile. Siphonozooids numerous between the autozooids. Axis developed to varying degrees: conspicuous, minute, or absent. Sclerites are plates, platelets, ovals, rods or spindles; none are three-flanged.

Distribution widespread in shallow tropical and subtropical seas, mostly from the Atlantic and Indo-Pacific, shallow sublittoral to approximately 190 m in depth. Five genera, four of which are included below, in addition to *Pollicella* Gray, 1870.

Genus *Cavernularia* Valenciennes *in* Milne Edwards & Haime, 1850

Veretillum: Philippi, 1835: 277. Gray, 1870: 28.
Cavernularia Valenciennes *in* Milne Edwards & Haime, 1850: 84. Kükenthal & Broch, 1911: 180 (Lit.!). Kükenthal, 1915: 12.
Sarcobelemnon Herklots, 1858: 25.
Stylobelemnon Kölliker, 1872*a*: 336. Balss, 1910: 79.
?Fusticularia Simpson, 1905: 561. Balss, 1910: 80.
?Parabelemnon J. A. Thomson & Simpson, 1909: 307.

Diagnosis

Colonies cylindrical, clavate or capitate. Sclerites are smooth ovals, rods or spindles; many are irregular in shape. Siphonozooids numerous and minute ($<0,3$ mm in diameter). Autozooids with or without sclerites. Axis variable; large to very small or absent. Colour usually white to cream, yellowish or greyish-white.

A genus of approximately 14 species. Indo-Pacific, west coast of Africa, Mediterranean Sea, and Bay of Biscay.

Type species. Cavernularia obesa Valenciennnes *in* Milne Edwards & Haime, 1850; Indian Ocean.

Cavernularia dayi Tixier-Durivault, 1954

Figs 2, 3, 38

Cavernularia Dayi Tixier-Durivault, 1954: 626, fig. 1.

Material

SAM–H3594 and SAM–H3595, off East London (33°02′S 27°56′E), 25–30 m, 16 July 1984, 6 specimens, dredge; G. C. Williams, R.V. *Meiring Naude*. SAM–H3817 and H3818, off Umlaas River, Natal (29°58′S 31°01′E), 50 m, 10 July 1985, 2 colonies, dredge; G. C. Williams, R.V. *Meiring Naude*.

Description

The colonies examined include three complete colonies, 23 mm, 30 mm and 70 mm in length, and five larger colonies, which have the proximal portions of the peduncles missing. These partial colonies are between 30 mm and 62 mm in length. Colonies club-shaped with tapering peduncle, length of which is 0,9–1,8 times the rachis length. Rachis conspicuously wider than peduncle. Autozooids concentrated on distal half of rachis; capable of complete retraction into rachis. Retracted autozooids less than 1,5 mm in diameter. Siphonozooids numerous, minute, *c.* 0,16 mm in diameter. Siphonozooids may extend down proximal portion of rachis, but are not conspicuous. Axis is a short rod (*c.* 8 mm long and 0,8 mm wide) in the centre of the proximal portion of the rachis. It is roughly circular in cross-section. The surface of the axis may be partially impregnated with oval sclerites. Axis length is less than 15 per cent of total colony length.

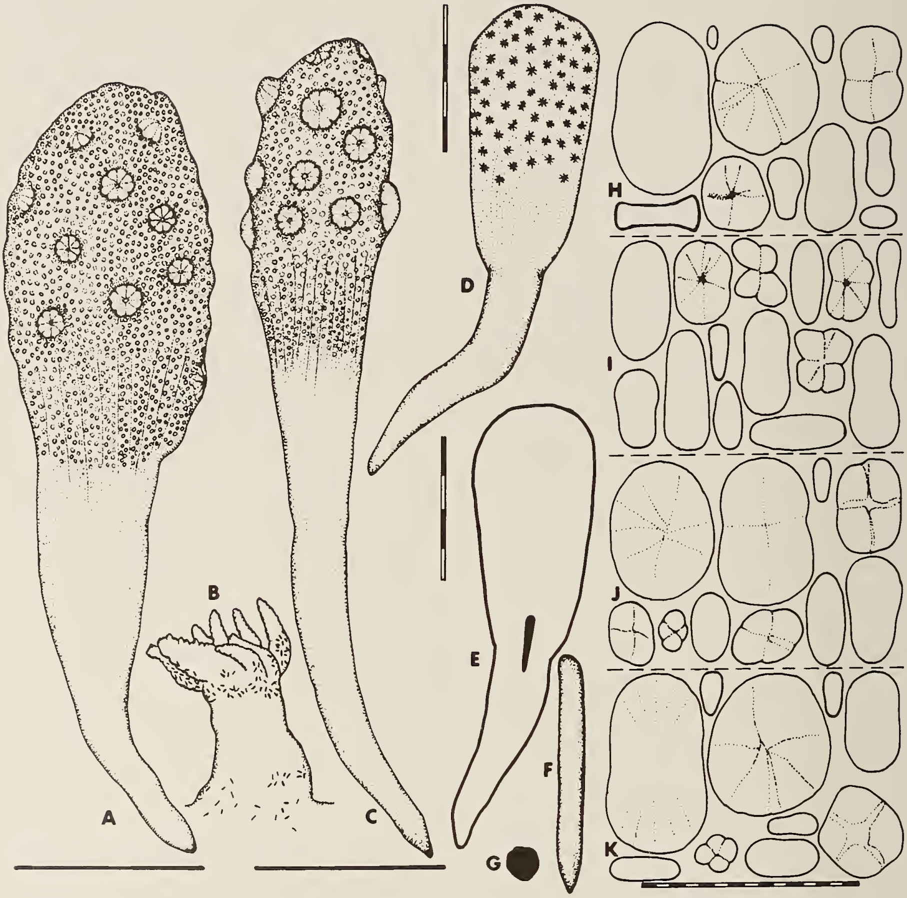

Fig. 2. *Cavernularia dayi*. A. Entire colony. Scale = 5 mm. B. Single autozooid showing placement of sclerites; polyp length 2,5 mm. C. Entire colony. Scale = 6 mm. D. Entire colony. Scale = 20 mm. E. Longitudinal section of a colony showing position of axis. Scale = 20 mm. F. Axis, length 8,0 mm. G. Cross section of axis, diameter 0,8 mm. H. Sclerites from surface of rachis. I. Sclerites from interior of rachis. J. Sclerites from surface of peduncle. K. Sclerites from interior of peduncle. Scale: H–K = 0,15 mm.

Sclerites are mostly small ovals, or elongate rods, usually 0,12 mm or less in length. They are present both in the rachis exterior and interior, as well as the peduncle exterior and interior. Some ovals may have a cross-pattern originating in the centre. Some sclerites of the rachis may be constricted in the middle with rounded or truncate ends. Sclerites are densely distributed, and are more or less consistent in shape throughout the colony. They vary from 0,02–0,13 mm in length. Autozooids may have a few scattered sclerites at the bases, extending up to less than one-third total length of polyp. The tentacles have many rod-like sclerites, 0,06 mm in length.

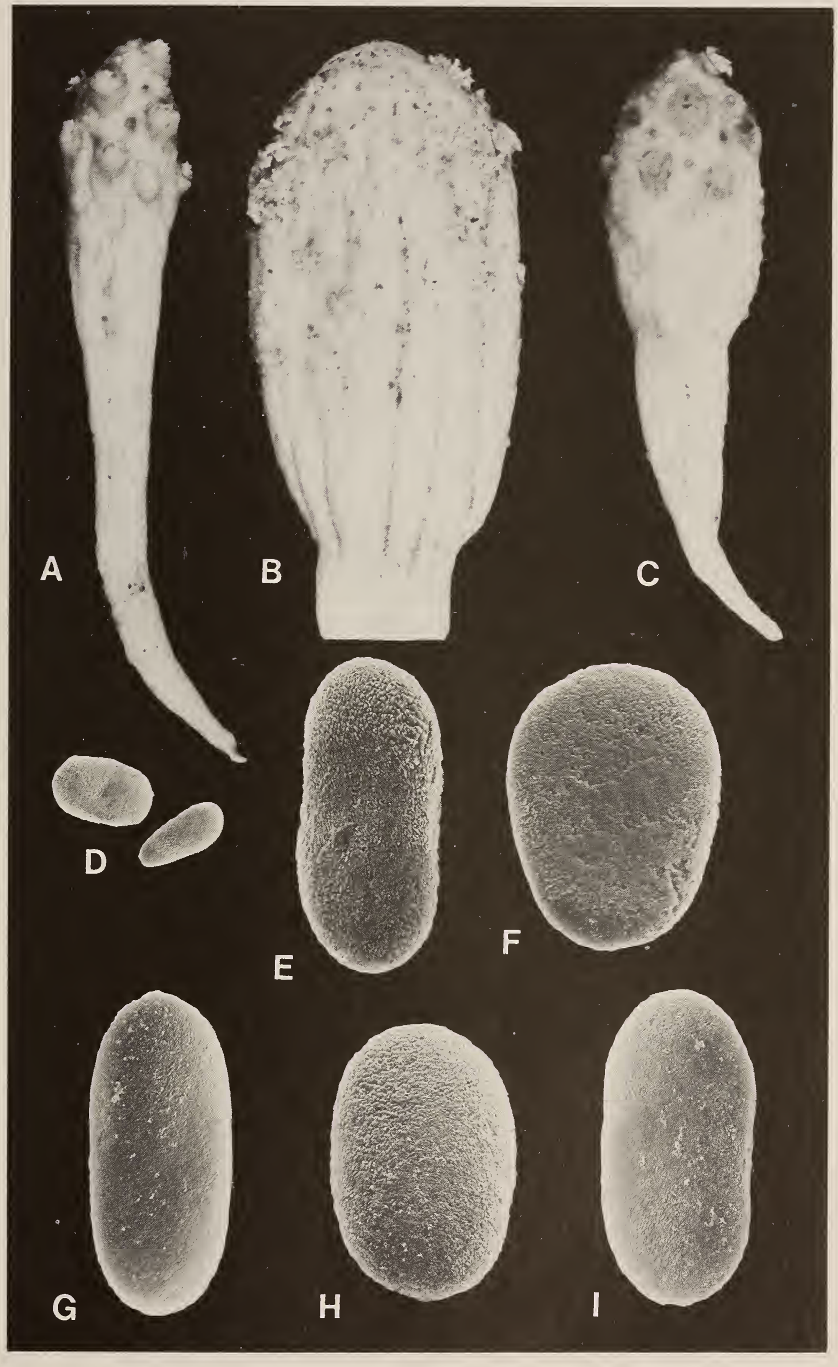

Fig. 3. *Cavernularia dayi*. A. Entire colony, length 30 mm. B. Partial colony, length 60 mm; peduncle absent. C. Entire colony, length 23 mm. D–I. Scanning electron micrographs of sclerites. D–F. From surface of peduncle. D. 0,04 mm. E. 0,03 mm. F. 0,03 mm. G–I. From surface of rachis. G. 0.04 mm. H. 0,03 mm. I. 0,07 mm.

Colour greyish-white in life. Neck zones of autozooids may have eight longitudinal subcutaneous regions of deep purple pigmentation, which is conserved in alcohol.

Distribution (Fig. 38)

East London to the northern Natal coast, 25–50 m depth. Tixier-Durivault (1954: 626) described the type locality from off Lake St. Lucia, Natal at 27 m depth. The present study extends the range from the type locality south-west to the eastern Cape Province, and north to Hully Point, Zululand. This species is possibly a southern African endemic but many more records are necessary to accurately establish its geographical distribution.

Remarks

Cavernularia dayi is distinguished from other southern African species of *Cavernularia* by its clavate shape, small axis, and short, robust, oval or rod-like sclerites of the rachis and peduncle.

Cavernularia elegans (Herklots, 1858)

Figs 4, 40

Sarcobelemnon elegans Herklots, 1858: 25, pl. 7 (fig. 3).
Veretillum elegans Richiardi, 1869: 127, pl. 13 (fig. 112).
Cavernularia elegans Kölliker 1872*a*: 165, pl. 23 (figs 207–208). Kükenthal & Broch, 1911: 185, text-figs 13–15, pl. 18 (fig. 29). Kükenthal, 1915: 16, fig. 20. Broch, 1958: 249.
Cavernularia elegans (*non* Herklots, 1858) Hickson, 1900: 89. J. A. Thomson & Simpson, 1909: 303. Balss, 1910: 86, figs 26–28.

Material

SAM–H3871, 67 km west of Cape Fria, Namibia (18°25′S 11°15′E), 274 m, May–June 1982, 9 colonies, trawl; collector unidentified.

Description

Colonies examined are 29–58 mm in length. Axis absent. Colonies clavate, with peduncle as long as the rachis or somewhat longer. Autozooids usually *c.* 1,3 mm in diameter. Siphonozooids conspicuous and numerous, in more or less longitudinal rows between autozooids, 0,1 mm in diameter. Peduncle slightly swollen near junction of rachis, with longitudinal striations on the external surface. Sclerites from base of autozooids as well as the surface of the rachis and peduncle are smooth elongate rods and spindles, 0,30–0,42 mm long. These are not three-flanged and may have bluntly rounded or somewhat pointed ends. In the rachis interior, similar sclerites are common; 0,2–0,4 mm long. The interior of the peduncle contains minute ovals, 0,01 mm in length.

Colour yellowish-white with some brownish pigmentation in the polyps below the tentacles.

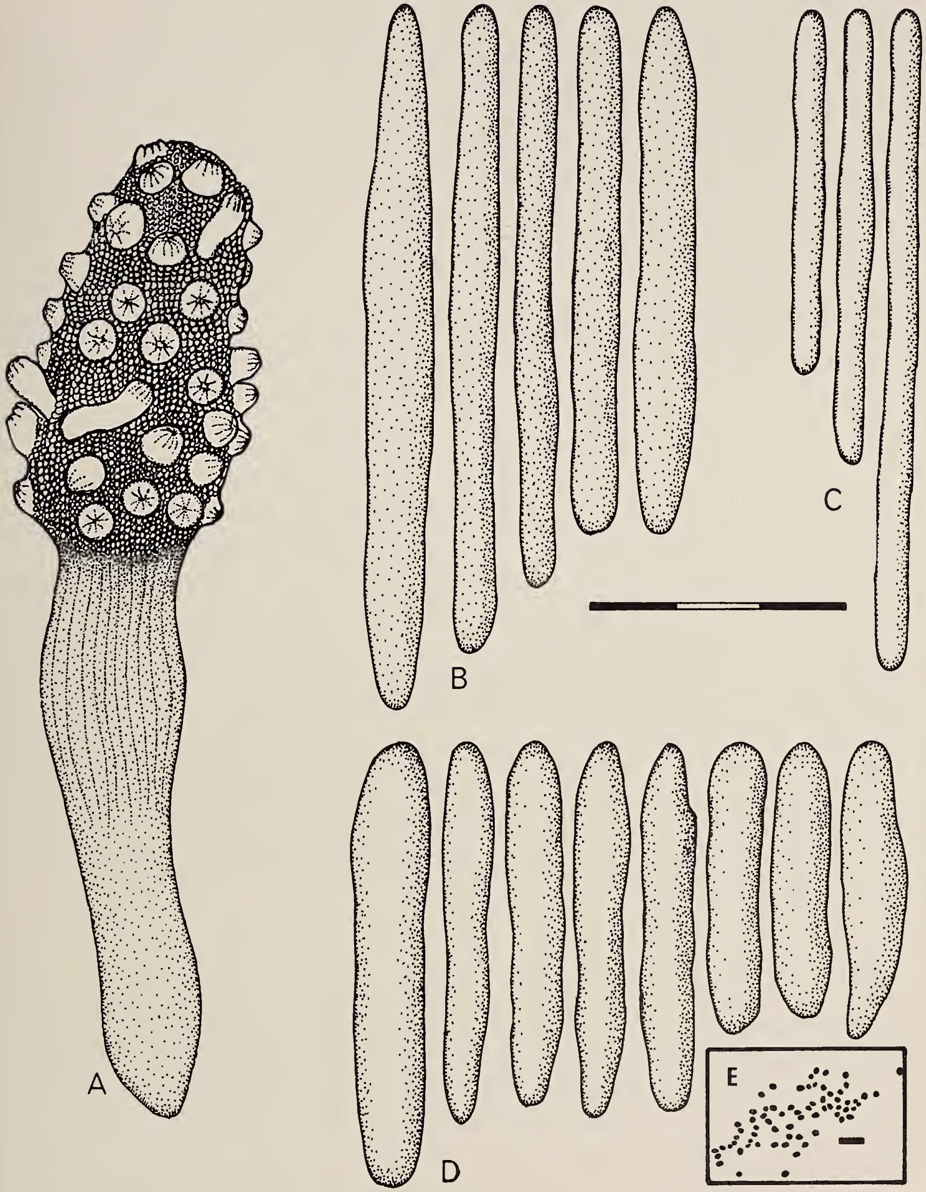

Fig. 4. *Cavernularia elegans*. A. Entire colony, total length 40 mm. B. Sclerites from surface of rachis. C. Sclerites from interior of rachis. D. Sclerites from surface of peduncle. B–D. Scale = 0,15 mm. E. Sclerites from interior of peduncle. Scale = 0,01 mm.

Distribution (Fig. 40)

Along the west African coast from Morocco to northern Namibia. The present study extends the range south from near Luanda, Angola, to the Skeleton Coast of Namibia, and represents a new record for southern Africa. The type locality is an unspecified station off the west African coast.

Remarks

One colony of *Cavernularia elegans* (Herklots, 1858) was recorded by Broch (1958: 249) from a depth of 65 m off the coast of Luanda, Angola. Tixier-Durivault (1963: 72) recorded one specimen as *C. pusilla* (Philippi, 1835) from Lobito Bay, Angola, at 35 m depth. These two species, together with *C. madeirensis* Studer, 1878, were considered synonymous by Broch (1958: 250), yet he retained *C. elegans* (instead of *C. pusilla*) as the correct binomial. I here consider *C. elegans* and *C. pusilla* as separate. Kükenthal (1915: 13) maintained that *C. pusilla* has irregular rod-shaped sclerites in the peduncle surface, whereas *C. elegans* has spindles. Balss (1910: 86) repeated Hickson's (1900: 89) misidentification of *Actinoptilum molle* as *C. elegans*, from 45 m depth off the Cape of Good Hope. Records of *C. elegans* from Japan (Balss 1910) and the Indian Ocean (J. A. Thomson & Simpson 1909) were considered dubious by Kükenthal (1915: 16). *Cavernularia elegans* is characterized by Kükenthal (1915: 13, 16) as having dense spindles at the surface of the peduncle, whereas these sclerites are absent in the peduncle interior; axis absent; sclerites from the surfaces of the peduncle and rachis are predominantly elongate rods and spindles. The rachis interior has similar sclerites but the peduncle interior has minute ovals. *Cavernularia obesa*, from the Indo-West Pacific, also lacks an axis, but possesses sclerites in the interior of the peduncle that are similar to those from the surface (according to Kükenthal, 1915: 13; also see D'Hondt 1984*b*: 634). *Cavernularia elegans* is distinguished from other southern African species of the genus by its clavate growth form, absence of an axis, and sclerites of elongate rods and spindles.

Remarks on the genus Cavernularia

Day *et al.* (1970: 17) listed *Cavernularia luetkeni* Kölliker, 1872, from 80–102 m depth in False Bay, near Cape Town. Since the specimen upon which this identification was made cannot be traced and since no description or figure is provided, it must be considered a dubious record. A 19-mm long specimen collected at Algoa Bay, near Port Elizabeth (SAM–H3236), was originally identified by Tixier-Durivault as *C. luetkeni*. I have examined this specimen and found the polyps to contain small bifurcated calyces. I therefore identify it as a young colony of *Actinoptilum molle* (Kükenthal, 1910). Tixier-Durivault (1960: 366) listed *C. luetkeni* from Inhaca Island, southern Mozambique. Material of *C. luetkeni* is not available at present for examination. Kükenthal (1915: 14) distinguished the species by the possession of a small axis in the base of the rachis and top part of the peduncle; stalk sclerites <0,19 mm long; and rachis sclerites <0,31 mm long.

Approximately 18 species of the genus have been named. Of these, four were considered dubious species or synonyms by Kükenthal (1915). Most of the recognized species are from the eastern Atlantic or Indo-West Pacific, and one is from the Pacific coast of Central America and the Galapagos Archipelago. The genus is in need of revision, since clear distinctions between some species are not evident from the literature. A comparison of type material is necessary to establish the validity of certain members of the genus.

Other species of the family Veretillidae

Four additional veretillid species have been recorded from southern Africa, but for three of these material is not presently available to the author for examination, and in one species only partial material is available.

Genus *Veretillum* Cuvier, 1798

Pennatula: Pallas, 1766: 177 (*partim*).
Alcyonium Linnaeus, 1767: 342 (*partim*).
Veretillum Cuvier, 1798: 675. Herklots, 1858: 26. Gray, 1870: 33. Kölliker, 1872*a*: 324. Balss, 1910: 79. Kükenthal & Broch, 1911: 175. Kükenthal, 1915: 11.

Diagnosis

Colonies cylindrical and plump or elongate and clavate. Size of axis variable, or altogether absent. Autozooids are distributed over surface of rachis; siphonozooids are contained in longitudinal rows between the autozooids. Sclerites are small plates ($<0{,}1$ mm), unbranched, often bone-shaped, biscuit-shaped, or at least constricted in the middle to some degree.

Three species from southern Europe, west coast of Africa, southern Mozambique and the Malay Archipelago.

Type species. Pennatula cynomorium Pallas, 1766; Europe.

Veretillum cynomorium (Pallas, 1766)

Figs 38, 40

Pennatula cynomorium Pallas, 1766: 177.
Alcyonium epipetrum Linnaeus, 1767: 1294.
Veretillum cynomorium Kükenthal & Broch, 1911: 176, pl. 13 (fig. 1), pl. 18 (figs 32–36) (Lit.!). Kükenthal, 1915: 12, figs 12, 13. Broch, 1958: 249. Tixier-Durivault, 1960: 362.

Material

Material was not available for examination.

Remarks

According to Kükenthal (1915: 11–12) colonies are cylindrical and plump, sausage-shaped, with rachis longer than peduncle. Siphonozooids in longitudinal rows. Sclerites are thin flat plates ($<0{,}06$ mm), usually medially constricted with ends rounded.

Broch (1958: 249–250) recorded this species from the Atlantic and Mediterranean coasts of southern Europe, and along the west African coast as far south as Walvis Bay, Namibia; the latter record follows Kükenthal & Broch (1911: 177). Molander (1929: 15) extended the range south to the mouth of the Orange River (border of Namibia and South Africa), 13 m depth. Tixier-Durivault (1960: 362) recorded a colony from Inhaca Island, southern Mozambique. The known depth range is 13–91 m.

Veretillum leloupi Tixier-Durivault, 1960

Fig. 38

Veretillum leloupi Tixier-Durivault, 1960: 363, figs 1–2.

Material

Material was not available for examination.

Remarks

According to Tixier-Durivault (1960: 363–365), colonies are long and narrow, clavate with stalk length equal to or longer than rachis. Siphonozooids not aligned in longitudinal rows. Sclerites are bone-shaped, not flattened, with medial constrictions and rounded ends, up to 0,1 mm in length.

The species is known only from the type locality at Inhaca Island, southern Mozambique, in the western Indian Ocean; depth not recorded.

Genus *Cavernulina* Kükenthal & Broch, 1911

Cavernularia J. A. Thompson & Simpson, 1909: 302 (*partim*).
Cavernulina Kükenthal & Broch, 1911: 172. Kükenthal, 1915: 9.

Diagnosis

Colonies clavate. Axis present. Sclerites of the rachis are mainly rods with bilobed or branched ends, usually $<0,4$ mm in length. Peduncle sclerites are smooth rods and spindles, most of which are not bilobed at the ends, and are mostly $<0,2$ mm in length. Polyps without sclerites.

Three species from the Indo-West Pacific.

Type species. Cavernularia cylindrica Kükenthal & Broch, 1911; Malay Archipelago.

Remarks

Cavernulina cylindrica Kükenthal & Broch, 1911, was listed without description or figures by Day *et al.* (1970: 17) from 33–36 m in False Bay, near Cape Town, as *Cavernularia cylindrica*. Since the specimen upon which this record was based is not available for examination and since this is the only False Bay record of the species known, it must be considered a dubious record. It is probable that small specimens from the Cape region, previously identified as species of *Cavernularia*, may in fact be young colonies of *Actinoptilum molle* in which the bifurcate calyces are neither prominent nor conspicuous, but present nonetheless. Two species were considered valid by Kükenthal (1915: 9): *Cavernulina cylindrica* and *C. orientalis* (Thomson & Simpson, 1909), both from the Indian Ocean. A third species, *C. grandiflora* D'Hondt, 1984, has recently been described from New Caledonia. See D'Hondt (1984*b*: 629) for a comparison of these three species.

Cavernulina sp.

Fig. 38

Remarks

A partial colony, in which only a 30 mm long rachis is present, recently collected from 62 m depth off the Durban region of Natal, possesses bilobed sclerites 0,1–0,25 mm in length. These sclerites are similar in shape and size to those figured by Kükenthal (1915: 10) for *C. cylindrica* and by D'Hondt (1984*b*: 628) for *C. grandiflora*. I therefore believe that this specimen belongs to the genus *Cavernulina*, but a proper identification to species is not possible due to the fragmentary nature of the material, in which the peduncle is entirely missing. The present study establishes the genus *Cavernulina* as a new record for southern Africa.

Genus *Lituaria* Valenciennes *in* Milne Edwards & Haime, 1850

Pennatula: Pallas, 1766: 179 (*partim*).
Veretillum: Lamarck, 1816: 420 (*partim*).
Lituaria Valenciennes *in* Milne Edwards & Haime, 1850: 84. Gray, 1870: 33. Kölliker, 1872*a*: 135. J. A. Thomson & Simpson, 1909: 311. Balss, 1910: 78. Kükenthal, 1915: 7.
Clavella Gray, 1870: 33. Kölliker, 1872*a*: 144. J. A. Thomson & Simpson, 1909: 311. Balss, 1910: 78.

Diagnosis

Colonies clavate. Axis contained in rachis, length variable, four-angled. Siphonozooids very numerous between the autozooids. Sclerites are small biscuit-shaped plates, many of which possess short branches or denticles at the ends. Other sclerites may be crosses or rods with warty ends.

Nine species of the Indo-Pacific. See Light (1921: 248) for a key to the species, and D'Hondt (1984*b*: 636) for a discussion of the type species.

Type species. Pennatula phalloides Pallas, 1766; Indian Ocean.

Lituaria valenciennesi D'Hondt, 1984*b*

Lituaria phalloides (*non* Pallas, 1766) Valenciennes *in* Milne Edwards & Haime, 1850: 84. Kölliker, 1872*a*: 313. Kükenthal, 1915: 8, fig. 6.
Lituaria valenciennesi D'Hondt, 1984*b*: 636, fig. 9.

Material

Material was not available for examination.

Remarks

According to Kükenthal (1915: 8), colonies are clavate with rounded distal ends. Polyps mostly without sclerites. Sclerites of the rachis and stalk are small flat plates up to 0,1 mm long, many with terminal denticles.

The species is recorded from Mozambique (undesignated station), the Malay Archipelago, the Andaman Islands, and Sri Lanka; shallow sublittoral.

Family **Echinoptilidae** Hubrecht, 1885

Colony digitiform or cylindrical. Axis absent. Rachis generally longer than peduncle. Colonies radially (Fig. 11B) to bilaterally symmetrical (Fig. 9B). Autozooids with distinctive, non-retractile, bifurcated calyces that are heavily armed with sclerites (Fig. 9A, E). Sclerites mainly smooth three-flanged rods or spindles, ovals and platelets (Fig. 13).

Two genera from the Indo-West Pacific to south-western Africa; shallow sublittoral to 835 m.

Genus *Echinoptilum* Hubrecht, 1885

Echinoptilum Hubrecht, 1885: 512. Balss, 1910: 37. Kükenthal & Broch, 1911: 196. Kükenthal, 1915: 18.

Actinoptilon Kükenthal, 1910: 54 (*partim*).

Diagnosis

Colony digitiform, commonly curved. Concave side with a longitudinal groove or furrow, and inverted V-shaped region at the base of the rachis devoid of polyps. This furrow may extend full length of rachis in small specimens (less than 40 mm). Proximal portion of rachis therefore bilaterally symmetrical. Distal portion of rachis may be radially symmetrical with polyp-bearing region continuous in larger specimens (over 40 mm). Autozooids with prominent bifurcated calyces, giving rachis a spiny or prickly appearance. Two terminal teeth of calyx deltoid to needle-like. Larger autozooids may be concentrated in two lateral series of longitudinal rows in colonies less than 40 mm long. Autozooids capable of total retraction into calyces. Siphonozooids numerous at base of autozooids; also with non-retractile, bifurcated calyces. Sclerites numerous; those of calyx are long three-flanged spindles, peduncle with ovals or three-flanged rods and spindles.

A genus of six species, Indo-West Pacific—Hawaii to eastern Africa.

Type species. Echinoptilum macintoshii Hubrecht, 1885; Japan.

Echinoptilum macintoshii Hubrecht, 1885

Figs 1H–I, 5, 6, 7A–C, 8D–F, 39

Echinoptilum macintoshii Hubrecht, 1885: 512, text-figs 1–3, pl. 30 (figs 1–8), pl. 31 (figs 9–14).

Echinoptilum macintoshi: Nutting, 1908: 561; 1912: 48. Balss, 1910: 38, pl. 2 (figs 1–3), pl. 5 (figs 1, 3–5). Kükenthal, 1915: 19. Utinomi, 1961: 221.

Echinoptilum Macintoshii: Kükenthal & Broch, 1911: 197.

Echinoptilum M'Intoshii: Hickson, 1916: 57–62.

Echinoptilum mackintoshi: J. A. Thomson & Rennet, 1927: 121, pl. 9 (fig. F). Bayer, 1956: 226.

Material

SAM–H3683, off Mbotyi, Transkei (31°32′S 29°50′E), 150–170 m, August 1981, 2 colonies, dredge; Natal Museum, R.V. *Meiring Naude*. SAM–H3685, off Port St. Johns, Transkei (31°39′S 29°35′E), 50–70 m, 14 August 1981, 1 colony, dredge; Natal Museum, R.V. *Meiring Naude*. SAM–H3819, off Mgazi River,

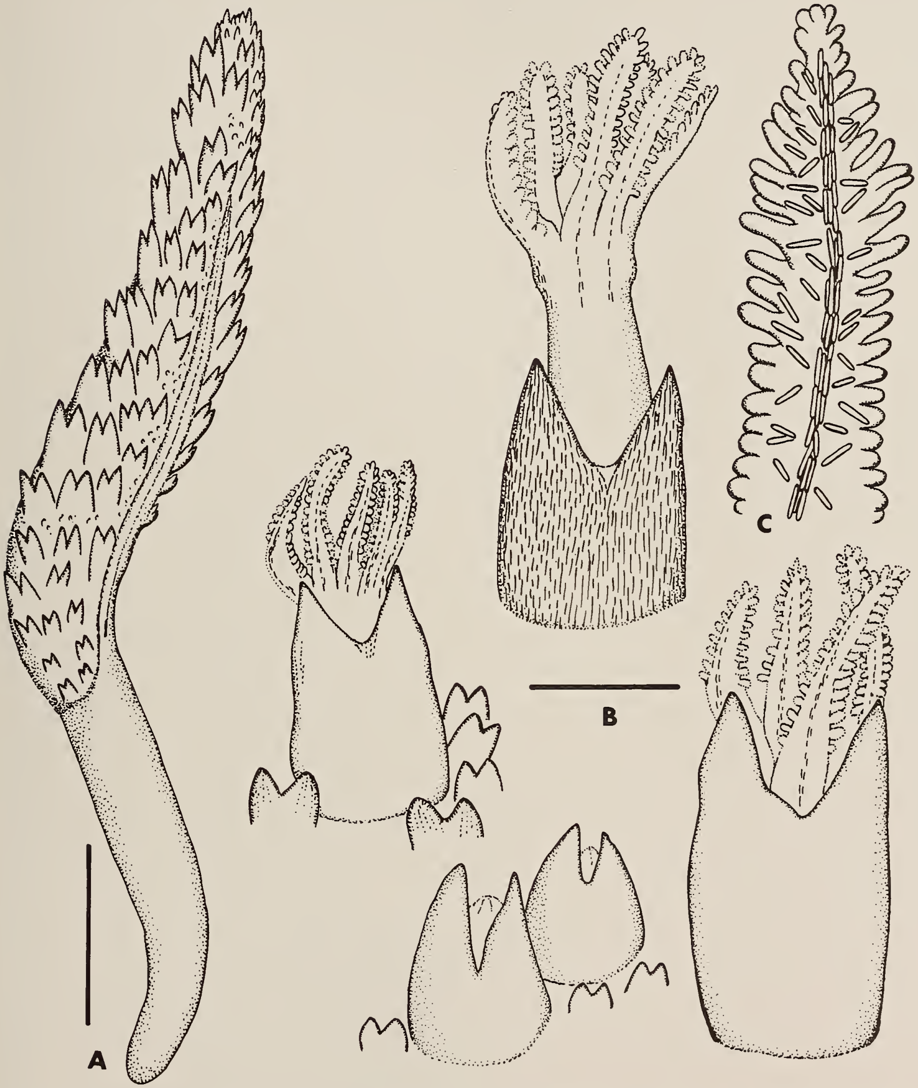

Fig. 5. *Echinoptilum macintoshii*. A. Entire colony, lateral view. Scale = 5 mm. B. Five autozooids with eight siphonozooids; sclerites shown in calyx of top autozooid only. Scale = 1 mm. C. Single tentacle (length 1,3 mm) showing alignment of sclerites.

Transkei (31°43,7′S 29°31,9′E), 140–145 m, 4 July 1985, 8 colonies, dredge; G. C. Williams, R.V. *Meiring Naude*.

Description

Specimens examined are 10–84 mm in length. Colonies curved with ventral groove on concave side. Calyx teeth conical to deltoid, 0,4–0,8 mm in length. Calyx length approximately twice the width. Entire calyces 1,2–2,3 mm in length. Siphonozooids have two broad teeth, often with obtuse tips.

Sclerites of the calyces are smooth three-flanged spindles 0,17–1,07 mm in length (Fig. 6A); aboral surface of each tentacle with a conspicuous longitudinal medial band of red-orange three-flanged rods, which extend into the base of the

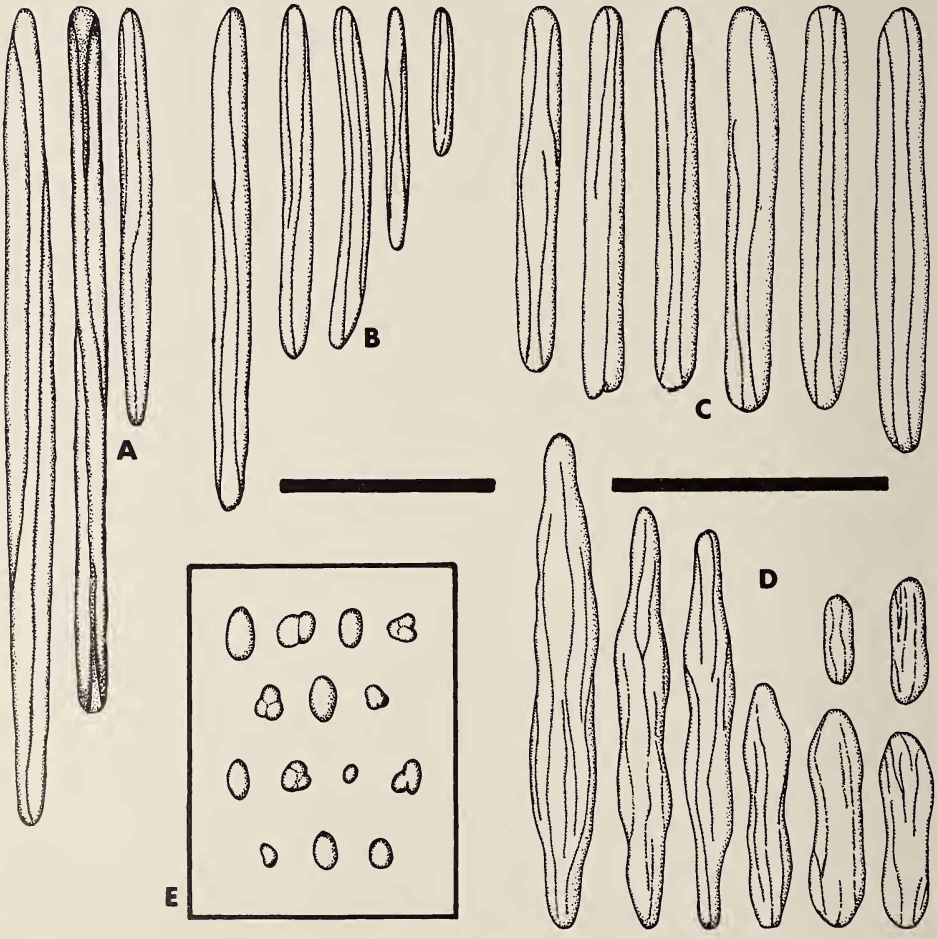

Fig. 6. *Echinoptilum macintoshii*. A. Calyx sclerites. B. Sclerites from surface and interior of rachis. C. Tentacular sclerites. D. Sclerites from surface of peduncle. E. Sclerites from interior of peduncle. Scales: A–B, D (left) = 0,2 mm; C, E (right) = 0,1 mm.

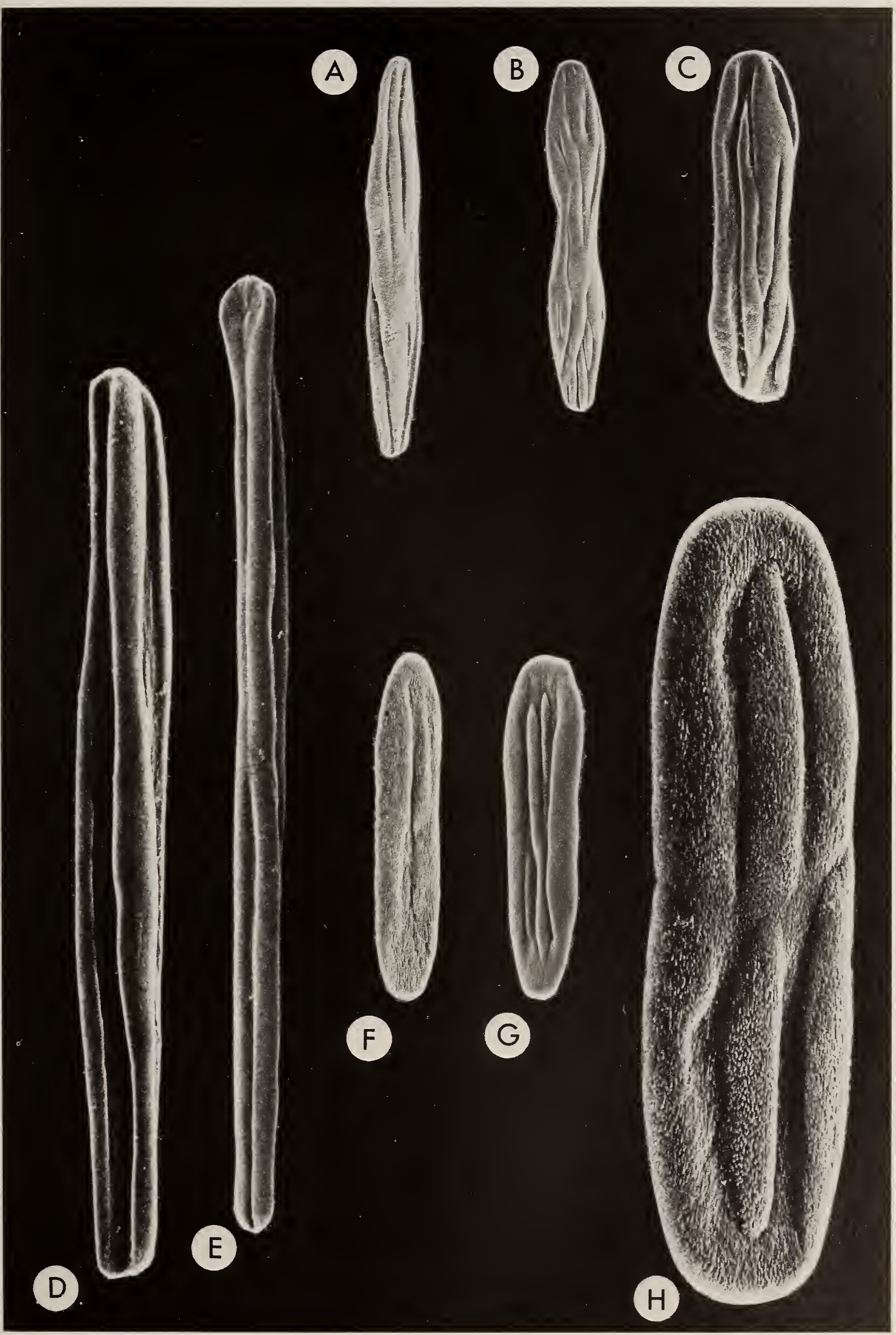

Fig. 7. Scanning electron micrographs of sclerites. A–C. *Echinoptilum macintoshii*. From surface of peduncle: 0,33 mm; 0,31 mm; 0,16 mm.D–H. *Echinoptilum echinatum*. D–E. From calyx: 0,17 mm; 0,55 mm. F–H. From surface of peduncle: 0,11 mm; 0,11 mm; 0,09 mm.

anthocodia. These are all arranged parallel to the axis of each tentacle and form a band 2–3 sclerites in width. Similar but colourless rods are found at various oblique angles to the axis, near the bases of the pinnules (Fig. 5C). The rods of the tentacles vary in length from 0,13–0,17 mm (Fig. 6C). Bare areas of the rachis surface, as well as the rachis interior, possess three-flanged spindles and rods 0,13–0,50 mm in length (Fig. 6B). Sclerites from the surface of the peduncle are longitudinally grooved (but not three-flanged) spindles or ovoid rods, 0,07–0,47 mm in length, often with undulate margins and tapering ends (Figs 6A–C, 6D). The tissues of the peduncular interior possess scattered sclerites of minute ovals 0,008–0,020 mm in length (Fig. 6E).

Rachis rust-orange to light reddish-brown. Peduncle and naked region of rachis whitish or cream. Calyces reddish-brown, often with margins edged in white. Colour of colony permanent, originating within the sclerites.

Distribution (Fig. 39)

Transkei coast, Japan and Hawaii. This study establishes a new record for the African coast and extends the range of the species to the western Indian Ocean. Colonies from south-eastern Africa are known from 50–170 m depth. Hubrecht (1885: 512) reported the type locality as the Sea of Japan, 130 m in depth. Nutting (1908: 561) recorded the species from the Hawaiian Archipelago, 225–258 m, and again off Japan, 150 m (Nutting 1912: 48).

Remarks

Echinoptilum macintoshii is distinguished from other members of the genus by having sclerites in the tentacles, and triangular calyx teeth <0,8 mm long.

Echinoptilum echinatum (Kükenthal, 1910)

Figs 1G, 7D–H, 8G–H, 9, 10, 39

Actinoptilon echinatum Kükenthal, 1910: 57.
Echinoptilum echinatum Kükenthal & Broch, 1911: 197, pl. 13 (fig. 3), pl. 18 (figs 38, 39), pl. 19 (figs 40–43). Kükenthal, 1915: 19 (fig. 21). Hickson, 1916: 57–62.

Material

SAM–H1595, off Durban (30°20′S 30°51′E), 406 m, 23 July 1964, 1 colony, dredge; Division of Sea Fisheries. SAM–H3680, off Mendu Point, Transkei (32°23′S 29°00′E), 450 m, 13 July 1984, 1 colony; G. C. Williams, R.V. *Meiring Naude*. SAM–H3681, off Qolora River, Transkei (32°48′S 28°37′E), 510 m, 14 July 1904, dredge; G. C. Williams, R.V. *Meiring Naude*. SAM–H3682, off Qora River, Transkei (32°35′S 28°49′E), 450–460 m, 14 July 1984, dredge; G. C. Williams, R.V. *Meiring Naude*. SAM–H3684, off Qora River, Transkei (32°34′S 28°50′E), 400–420 m, 12 July 1984, dredge; G. C. Williams, R.V. *Meiring Naude*. SAM–H3820, off Mbashe River, Transkei (32°23,6′S 28°59,2′E), 350 m maximum, 6 July 1985, 1 colony, dredge; G. C. Williams, R.V. *Meiring Naude*.

Description

Specimens examined are 30–80 mm in length. Colonies curved with ventral groove on concave side. Calyx teeth lanceolate to needle-like, 1,0–1,6 mm in length. Total calyx length (approximately 3 mm) is more than twice and often three times the width. Siphonozooids possess two narrow teeth with acute tips.

Sclerites of the calyces are narrow, three-flanged spindles 0,14–0,86 mm long (Figs 7D–E, 10A). The aboral surface of each tentacle has a medially placed longitudinal row of 1–20 sclerites, arranged more-or-less parallel to the axis of the tentacles (Fig. 9C–D). These are three-flanged rods 0,10–0,16 mm in length (Fig. 10C). Bare regions of the surface of the rachis, as well as the interior of the rachis, possess elongate three-flanged rods 0,06–0,35 mm in length (Fig. 10B). The peduncular surface sclerites are oval finger-biscuits with longitudinal striation (but not three-flanged) 0,04–0,15 mm in length (Figs 7F–H, 10D). The tissues of the interior of the peduncle possess minute ovals 0,009–0,014 mm in length (Fig. 10E).

Calyces and rachis are brick red or deep reddish-purple to cream. Peduncle, as well as the naked longitudinal track on the concave side of the rachis are whitish to cream, often with reddish longitudinal lines. Colour permanent due to pigmentation of the sclerites.

Distribution (Fig. 39)

Transkei and Natal coasts to Somalia. South-east African specimens from 350–510 m depth. Kükenthal & Broch (1911: 197) reported the type locality as off the Somalia coast at 628 m depth. The present study extends the range of the species southward along the coast of east Africa, and represents a new record from southern Africa.

The two south-east African species of *Echinoptilum* apparently show divergent bathymetric ranges: *E. macintoshii* has a shallow-water distribution, being encountered at depths of 130–258 m, whereas *E. echinatum* is presumably a deeper-water form, known only between 350 m and 628 m in depth.

Remarks

Echinoptilum echinatum is distinguished from other species of the genus by having sclerites in the tentacles, and lanceolate calyx teeth up to 1,6 mm long.

Remarks on the genus Echinoptilum

Four other species of *Echinoptilum* were described by Hickson (1916) from the Malay Archipelago: *E. elongatum*, *E. minimum*, *E. roseum*, and *E. asperum*. These species have not been recorded outside their respective type localities.

Hickson (1916: 62) presented a key to the six described species. *Echinoptilum macintoshii* is characterized by having pronounced curvature, spicules in the tentacles, and small calyxes, whereas *E. echinatum* is also described as being curved with spicules in the tentacles, but with large calyces. The southern African material agrees with Hickson's descriptions of these two species, as well as the

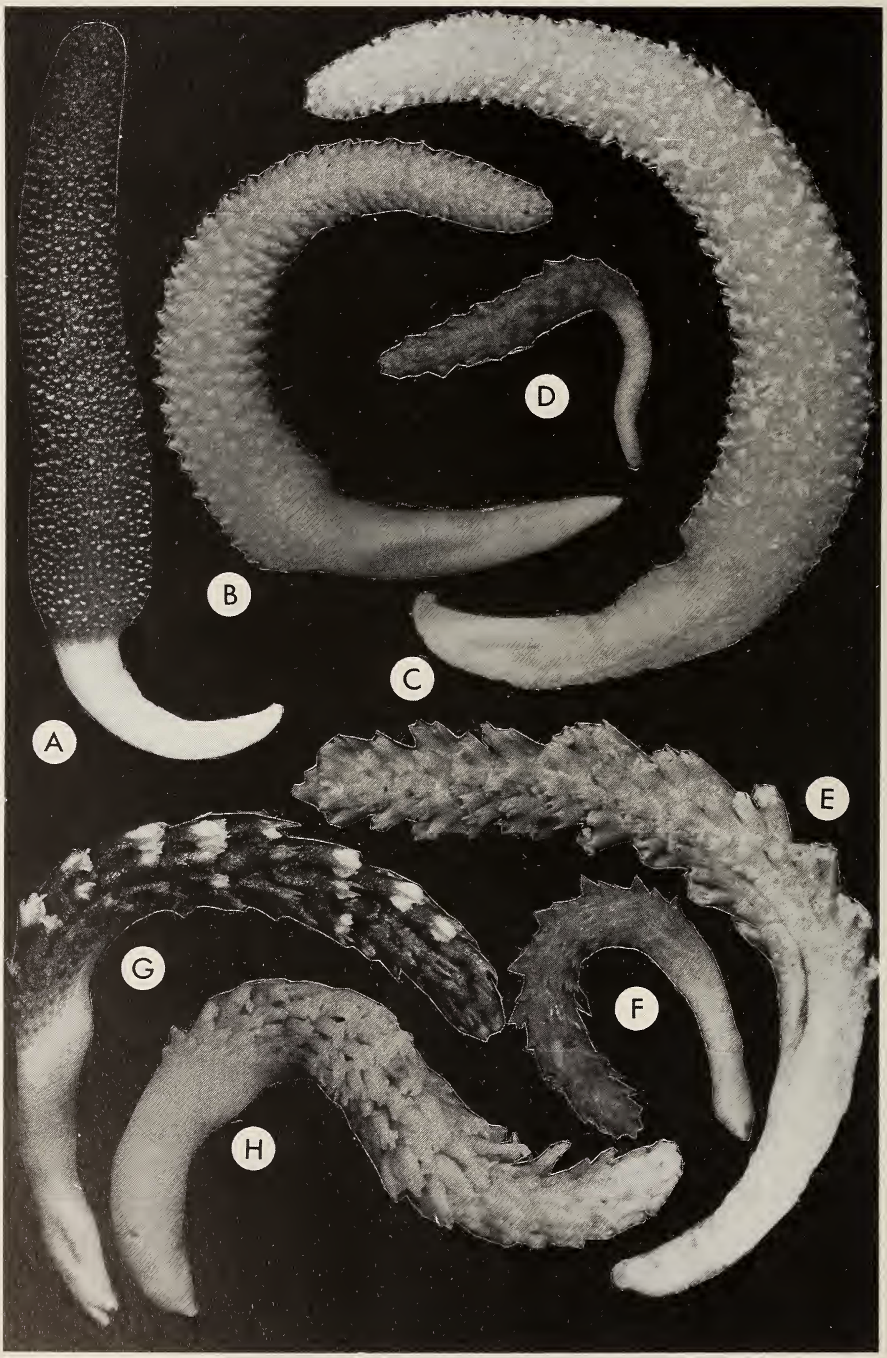

Fig. 8. A–C. *Actinoptilum molle* colonies. A. 70 mm. B. 65 mm. C. 85 . D–F. *Echinoptilum macintoshii*. D. 25 mm. E. 45 mm. F. 35 mm. G–H. *Echinoptilum echinatum*. G. 40 mm. H. 55 mm.

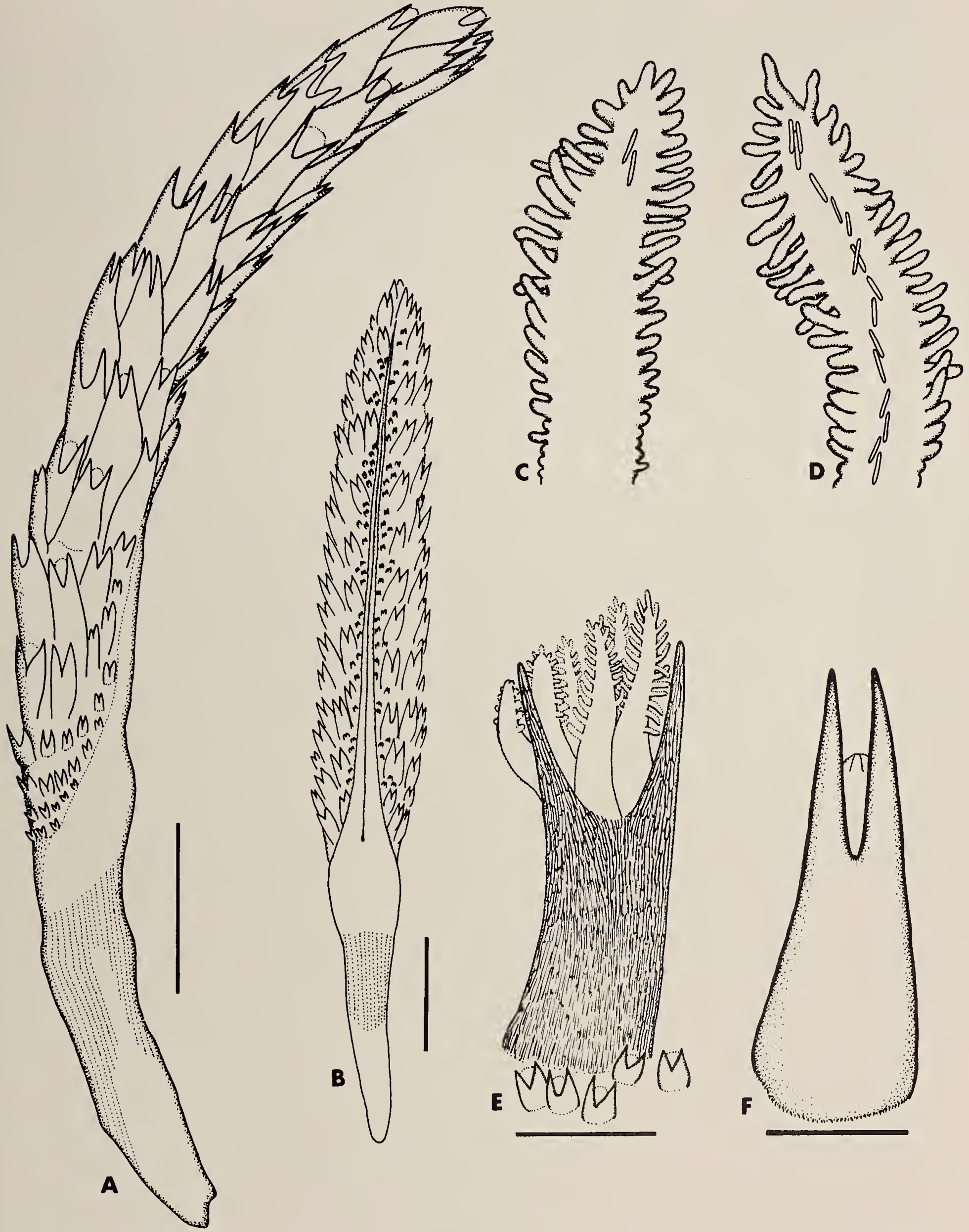

Fig. 9. *Echinoptilum echinatum*. A. Entire colony, lateral view. Scale = 5 mm. B. Ventral view of colony showing naked tract. Scale = 5 mm. C–D. Two tentacles, showing variation in sclerite density and placement. Each tentacle is 2,0 mm in length. E. Single autozooid, partially retracted; calyx sclerites shown, five siphonozooids at base. Scale = 1 mm. F. Single bifurcated calyx of a retracted autozooid; sclerites omitted. Scale = 1 mm.

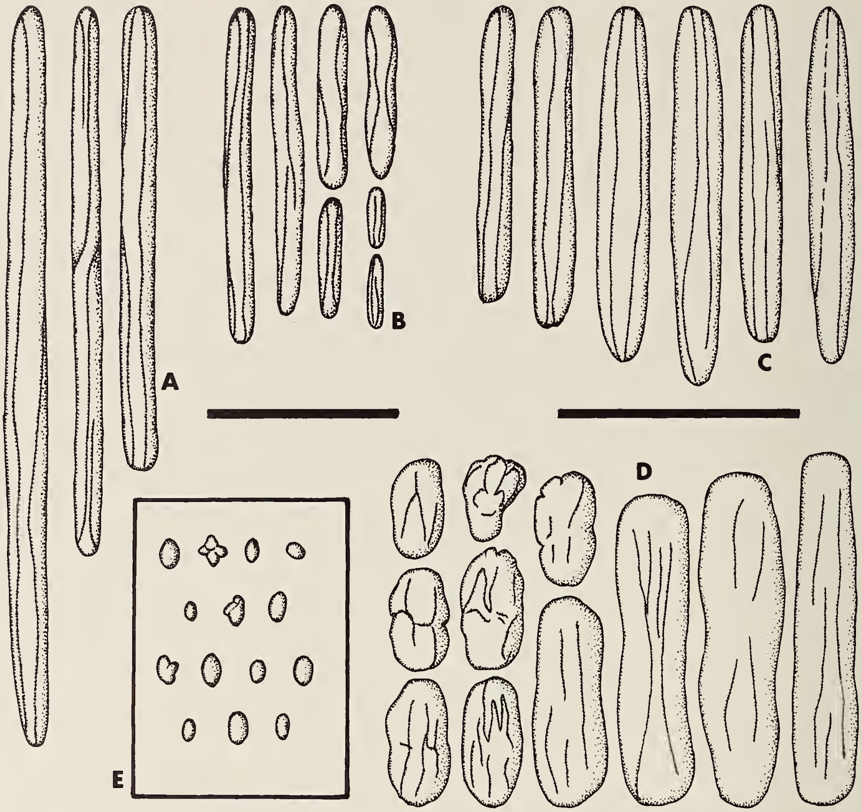

Fig. 10. *Echinoptilum echinatum*. A. Calyx sclerites. B. Sclerites from surface and interior of rachis. C. Tentacular sclerites. D. Sclerites from surface of peduncle. E. Sclerites from interior of peduncle. Scales: A, B (left) = 0,2 mm; C, D, E (right) = 0,1 mm.

detailed descriptions of Hubrecht (1885: 512) and Kükenthal & Broch (1911: 197).

The distinctions between the various groups may not be consistent or marked enough to warrant specific separation. Hickson (1916: 58) raised the possibility that the genus *Echinoptilum* is monospecific and that the six described species may in fact represent one highly variable and widespread species. A comparative examination of type specimens and other known material is needed. However, the differences between *E. macintoshii* and *E. echinatum*, based upon comparison of the available southern African material, are marked and consistent.

Genus *Actinoptilum* Kükenthal, 1911

Cavernularia (*non* Valenciennes *in* Milne Edwards & Haime, 1850) Hickson, 1900: 89, 92.
Actinoptilon Kükenthal, 1910: 56.
Actinoptilum Kükenthal & Broch, 1911: 201. Kükenthal, 1915: 20.
Actinoptinum Day *et al.*, 1970: 17.

Diagnosis

Colony cylindrical with rachis radially symmetrical. Polyps evenly distributed and completely covering surface of rachis. Calyces of autozooids usually less than 3 mm in length, bifurcate. Terminal teeth short and conical to deltoid or broadly lanceolate and acute. Inside of each tooth often with a fleshy rounded protuberance near the apex.

A monospecific genus restricted to southern Africa and possibly Madagascar.

Type species. Actinoptilon molle Kükenthal, 1910; South Africa.

Actinoptilum molle (Kükenthal, 1910)

Figs 1A–C, 8A–C, 11–13, 39

Cavernularia obesa (*non* Valenciennes *in* Milne Edward & Haime, 1850) Hickson, 1900: 92, pl. 3 (figs A–B).
Cavernularia elegans (*non* Herklots, 1858) Hickson, 1900: 89.
Actinoptilon molle Kükenthal, 1910: 57 (*partim*). Tixier-Durivault, 1960: 366. Tixier-Durivault & D'Hondt, 1974: 259.
Actinoptilum molle Kükenthal & Broch, 1911: 201, pl. 13 (figs 3–4), pl. 18 (fig. 37). Kükenthal, 1915: 20, figs 22–24. J. S. Thomson, 1915: 3. 1924: 81. Hickson, 1916: 41. Molander, 1929: 15. Tixier-Durivault, 1954: 628. Broch, 1958*b*: 251.
Actinoptilum molle var. *maculatum* J. S. Thomson, 1915: 5.
Actinoptilum molle var. *intermedium* J. S. Thomson, 1915: 7.
Actinoptilum molle var. *zonatum* J. S. Thomson, 1915: 8.
Actinoptinum molle Day *et al.*, 1970: 17.

Material

SAM–H3254, Port Elizabeth Harbour (33°58′S 25°38′E), 20–25 m, February 1984, 2 colonies, small dredge; W. R. Liltved. SAM–H3263, Algoa Bay (33°59′S 25°42′E), 20 m, February 1984, 2 colonies, SCUBA; W. R. Liltved. SAM–H3164, off Jeffrey's Bay (34°00′S 25°10′E), 30 m, August 1980, 6 colonies, dredge; W. R. Liltved, R.V. *T.B. Davie*. SAM–H3272, False Bay (34°09′S 18°27′E), 26 February 1984, 12 m, 1 colony, small dredge; W. R. Liltved. SAM–H3339, Algoa Bay (33°59′S 25°42′E), 16 m, 17 May 1984, 3 colonies, SCUBA; G. C. Williams.

Description

Colonies examined range in length between 12 mm and 240 mm. Colony cylindrical, plump, sausage-shaped. Peduncle thick, tapering gradually, usually one-fifth to one-third total colony length. Rachis tapering gradually to a rounded apex. Rachis entirely covered with dimorphic polyps; thus the polyp-bearing surface of the rachis is radially arranged. Siphonozooids crowded between bases of autozooids with minute bifurcated calyces. Rachis surface often with longitudinal lines between columns of autozooids. Calyces of autozooids usually not conspicuous, bifurcate, non-retractile. Autozooids capable of total retraction into calyces. Calyx teeth variable in shape and length.

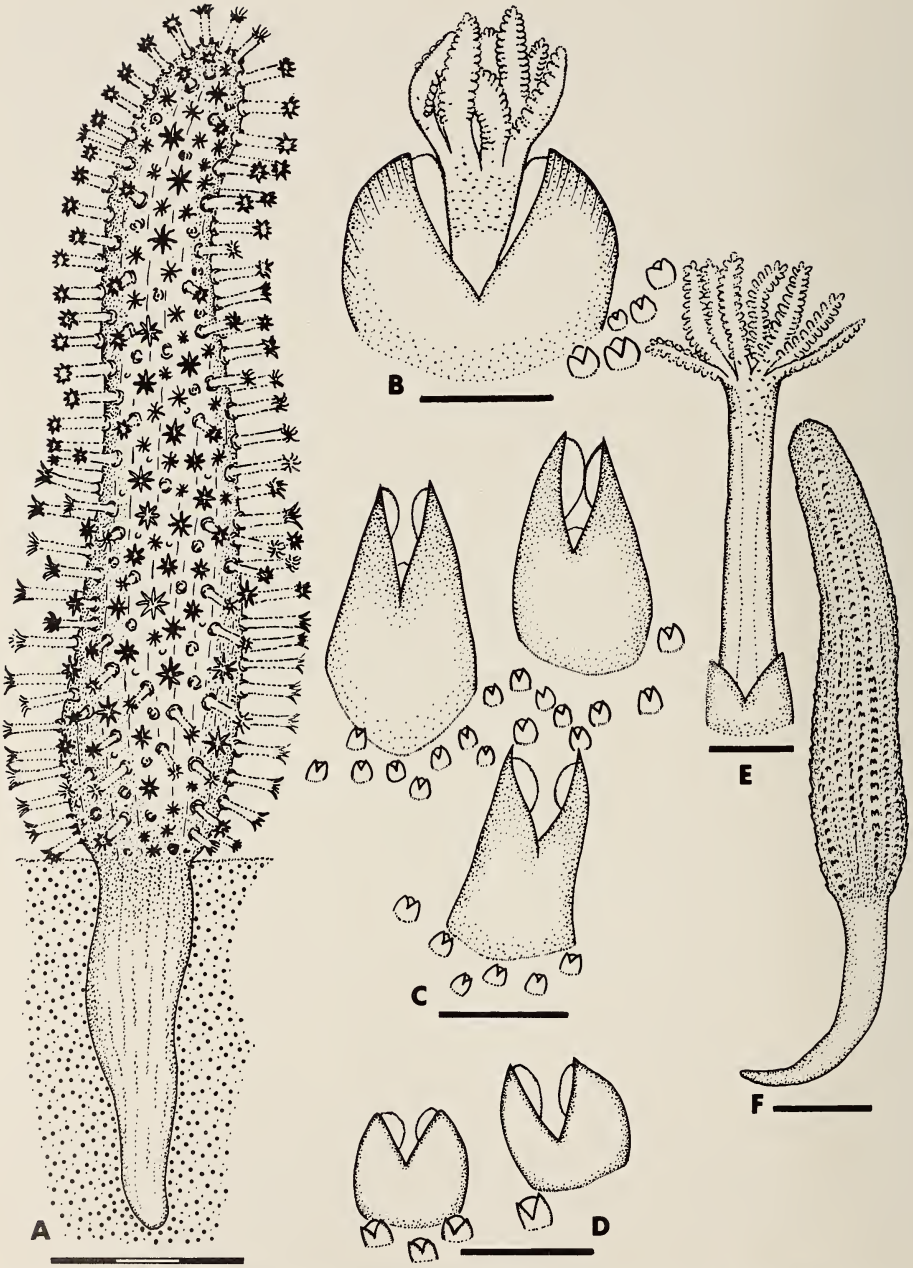

Fig. 11. *Actinoptilum molle*. A. Expanded colony *in situ*. Scale = 30 mm. B. Single autozooid and five siphonozooids. C. Three autozooids retracted into calyces, and numerous siphonozooids. D. Two autozooid calyces with four smaller siphonozooids. Scales: B–D = 0,8 mm. E. Expanded autozooid. Scale = 1,8 mm. F. Preserved colony with retracted polyps. Scale = 10 mm.

Sclerites of the calyx are smooth three-flanged spindles 0,18–0,85 mm long (Figs 12A, 13A–D). Anthocodia (distal part of polyp that contains the tentacles, mouth, and neck zone) with small ovals or platelets in neck zone and base of tentacles, 0,02–0,04 mm in length (Figs 12B, 13E). The surface of the rachis has three-flanged spindles and rods 0,22–0,42 mm in length (Figs 12C, 13F, H–I). The tissues of the interior of the rachis possess similar sclerites 0,22–0,41 mm in length (Fig. 12D). The surface of the peduncle has ovoid finger biscuit-shaped sclerites with longitudinal surface striations 0,03–0,20 mm long (Figs 12E, 13G). The tissues of the peduncular interior possess minute ovals 0,005–0,020 mm in length (Fig. 12F).

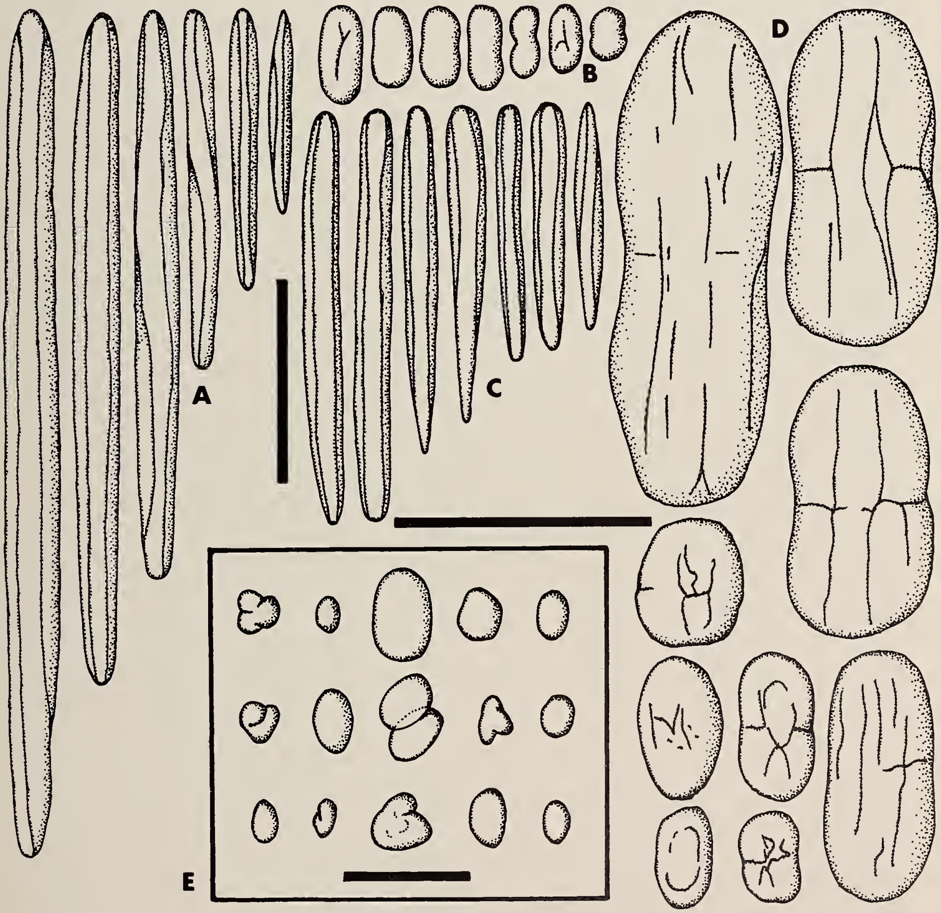

Fig. 12. *Actinoptilum molle*. A. Calyx sclerites. B. Sclerites from anthocodial wall. C. Sclerites from rachis surface and interior. D. Sclerites from surface of peduncle. E. Sclerites from interior of peduncle. Scales: A, C (left) = 0,2 mm; B, D (right) = 0,1 mm; E = 0,02 mm.

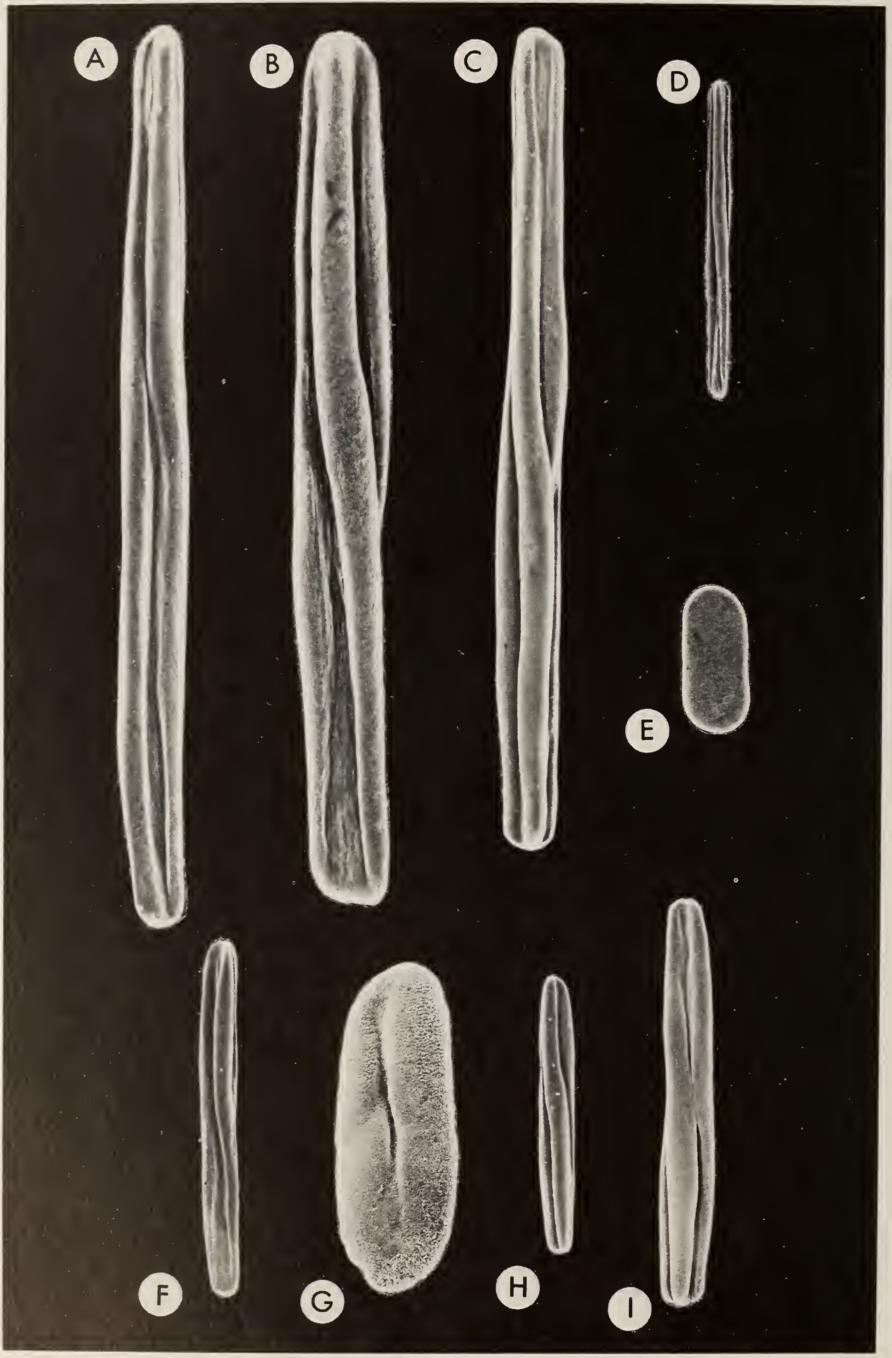

Fig. 13. Scanning electron micrographs of sclerites of *Actinoptilum molle*. A–D. From calyx: 0,41 mm; 0,21 mm; 0,45 mm; 0,44 mm. E. From tentacle: 0,04 mm. F, H, I. From surface of rachis: 0,2 mm; 0,15 mm; 0,2 mm. G. From surface of peduncle: 0,07 mm.

Colour highly variable; individual colonies may be entirely yellow, white to cream, reddish-brown, pinkish or mauve; or colonies with rachis deep-purple to reddish-purple, and peduncle yellow, white, pinkish or brownish. Colour permanent, originating within the sclerites.

Distribution (Fig. 39)

This species is presumably a southern African endemic, known from off Cape Columbine on the west coast of South Africa to Inhaca Island, Mozambique, at depths ranging from 12 m to 333 m. However, Tixier-Durivault & D'Hondt (1974: 259) recorded, without description or figures, seven colonies from north-eastern Madagascar between 200 m and 605 m in depth. The species is perhaps the most frequently encountered pennatulacean in South African coastal waters.

Observations

A 60-mm long live colony from False Bay (SAM–H3272), which was kept in a bucket of sea-water at night, was observed to luminesce vigorously when agitated; the rachis sparkled throughout with minute pinpoints of green light.

SCUBA divers have observed this species inhabiting rocky reefs off Cape Agulhas at 48 m depth. A colony was observed in a small depression in rocky substratum that was filled with fine sediment (W. R. Liltved pers. comm.). Divers have also observed extensive sandy areas at 20 m depth in False Bay with a density of 4–5 colonies per square metre (P. Williams pers. comm.).

Remarks

Thomson (1915: 1–13) named three varieties of *Actinoptilum molle* based primarily on differences in external coloration: *A. molle* var. *maculatum*, *A. molle* var. *intermedium*, and *A. molle* var. *zonatum*. Because of the wide range of colour variability observed throughout the geographic extent of the species and many gradations between various colonies or populations, I believe that formal subspecies or varieties should not be designated. This species can be regarded as yet another example of the extreme range of variability exhibited by sedentary benthic organisms such as octocorallians. Thomson (1915: 8) observed a slight trace of a groove on the rachis of four white colonies that he referred to *A. molle* var. *intermedium*. A conspicuous groove or furrow on the concave side of the rachis is considered diagnostic of the genus *Echinoptilum*. However, according to Thomson, the four specimens show typical characteristics of *Actinoptilum*, such as smaller inconspicuous calyces and numerous polyps arranged almost completely radially, as well as the form, dimensions, and distribution of sclerites being similar to those described by Kükenthal for *A. molle*. Calyx length is also quite variable, ranging from 1 mm to 3 mm. In some colonies the calyx teeth are only visible with the aid of a hand lens or dissecting microscope, whereas in others they are very conspicuous and easily seen with the unaided eye.

Kükenthal (1915: 20) stated that the polyps are without sclerites. The density of sclerites in the anthocodiae is variable; in a single colony some anthocodiae may contain sclerites, whereas others may contain none. The number of ovals present in a particular anthocodia is also quite variable.

Actinoptilum molle is distinguished from other southern African sea pens by having radial symmetry of the rachis, in which the polyps are distributed evenly on all sides, and the possession of generally inconspicuous calyx teeth.

Family **Kophobelemnidae** Gray, 1860

Colonies clavate (club-shaped). Axis present. Polyps arranged bilaterally along rachis; rachis may show a tendency toward radial symmetry. Autozooids large, without calyces. Siphonozooids with calyces, at base of autozooids. Rachis with sclerites of three-flanged or tuberculate spindles, or plate-like, biscuit-shaped or bone-shaped rods.

Four genera from the Atlantic, Mediterranean and Indo-Pacific: *Mesobelemnon* Gravier; 1907; *Sclerobelemnon* Kölliker, 1872*a*; *Kophobelemnon* Asbjørnsen, 1856; and *Malacobelemnon* Tixier-Durivault, 1966*a*. The present study represents the first record of the family for southern Africa.

Genus *Kophobelemnon* Asbjørnsen, 1856

Kophobelemnon Asbjørnsen, 1856: 81. Kükenthal & Broch, 1911: 219. Kükenthal, 1915: 29 (Lit.!).
Bathyptilum Kölliker, 1872: 200.
Gunneria Danielssen & Koren, 1884: 58.

Diagnosis

Colony clavate, elongate, stiff. Distal end slightly expanded and rounded, knob-like, or slightly pointed at the tip. Rachis and stalk about equal in length. Axis thin, often slightly quadrangular in transverse section. Sclerites are mostly three-flanged spindles that may possess tubercles.

A genus of eight to ten species. Atlantic, Mediterranean, and Indo-Pacific; mostly deep sea, 40–4 400 m.

Type species. Pennatula stellifera Müller, 1776; northern Atlantic.

Kophobelemnon stelliferum (Müller, 1776)

Figs 14–16, 40

Pennatula stellifera Müller, 1776: 255.
Kophobelemnon stelliferum Kükenthal & Broch, 1911: 224, figs 54–60. Kükenthal, 1915: 29, figs 40–41 (Lit.!).

Material

SAM–H3707, off Skeleton Coast, Namibia (20°59′S 12°23′E), 486–605 m, 20 August 1982, 1 colony, bottom trawl; Sea Fisheries Research Institute, Crab Survey. SAM–H4026 off Skeleton Coast, Namibia (*c.* 21°00′S 12°00′E),

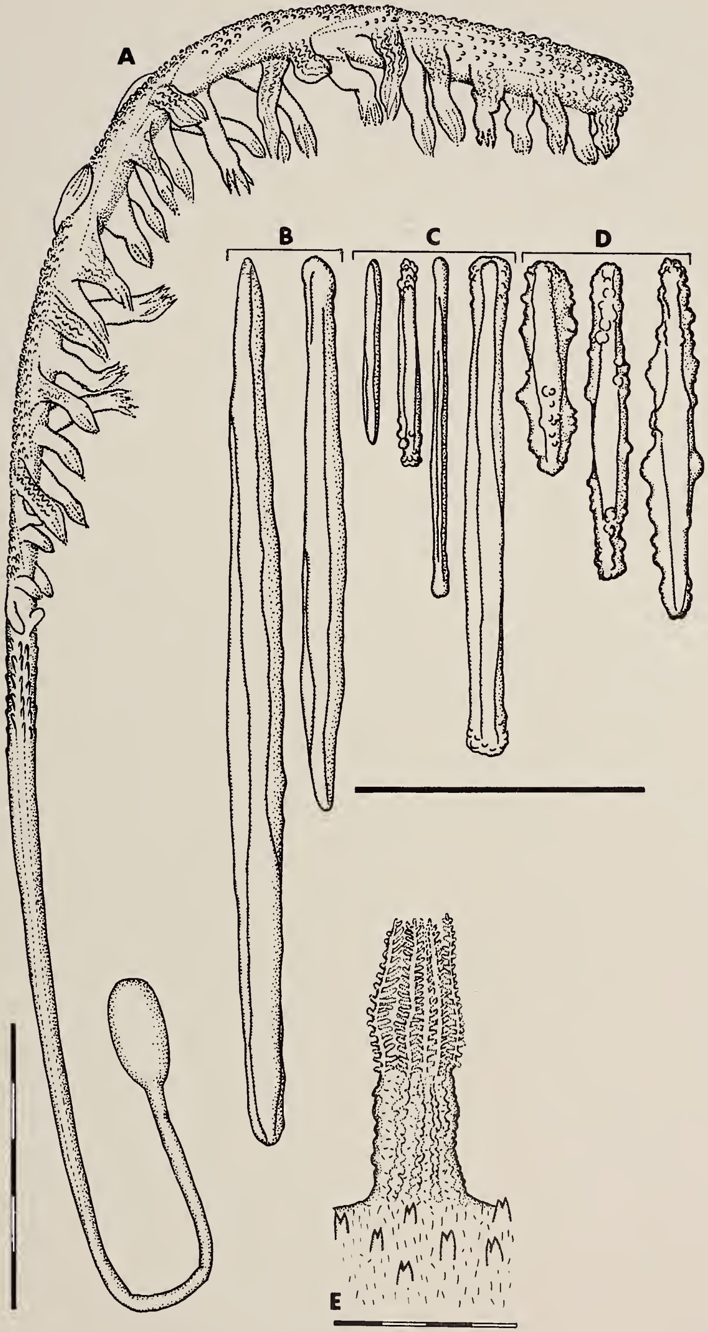

Fig. 14. *Kophobelemnon stelliferum*. A. Entire colony. Scale = 50 mm. B. Sclerites from surface of rachis. C. Sclerites from wall of an autozooid. D. Sclerites from surface of peduncle. Scale: B–D = 0,2 mm. E. Detail of single autozooid and seven siphonozooids. Scale = 8 mm.

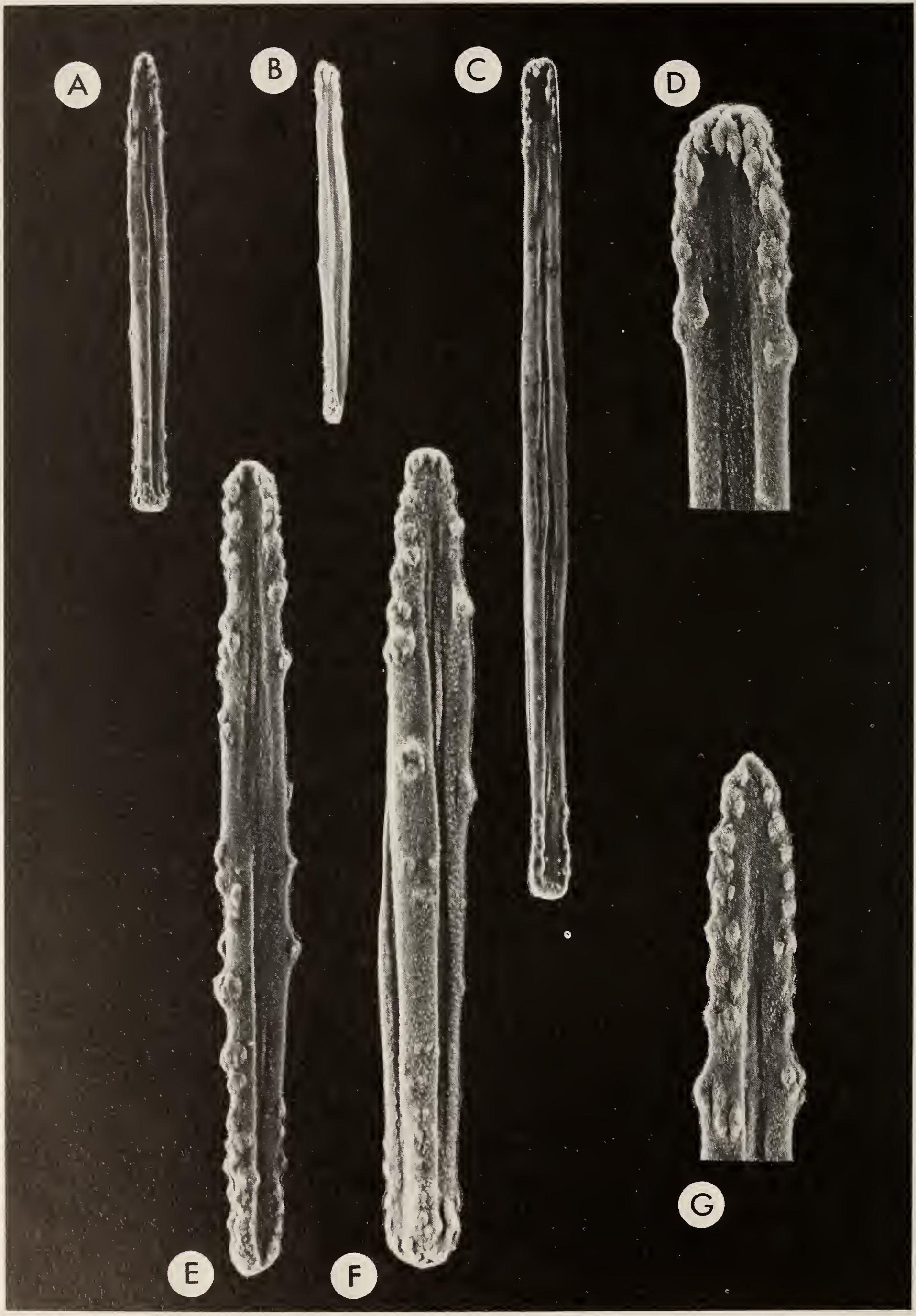

Fig. 15. Scanning electron micrographs of sclerites of *Kophobelemnon stelliferum*. A–C. From rachis: 0,32 mm; 0,33 mm; 0,59 mm. D. Tip of rachis sclerite: 0,08 mm. E–F. From peduncle: 0,26 mm; 0,24 mm. G. Tip of peduncle sclerite: 0,1 mm.

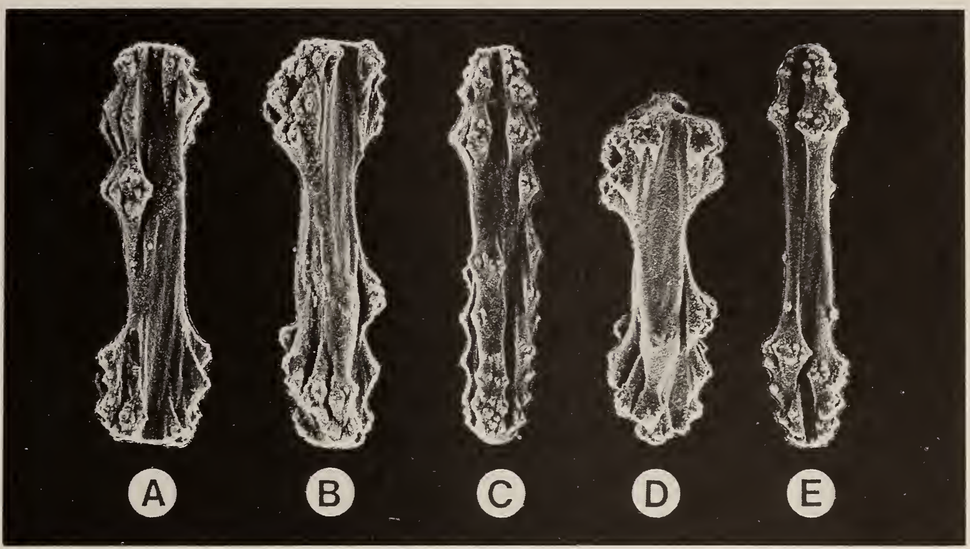

Fig. 16. *Kophobelemnon stelliferum*. Scanning electron micrographs of sclerites from base of peduncle: A. 0,14 mm; B. 0,14 mm; C. 0,16 mm; D. 0,13 mm; E. 0,19 mm.

450–650 m, February 1987, 10 colonies, bottom trawl, R. Melville Smith, Sea Fisheries Research Institute, Crab Survey.

Description

The colony, SAM–H3707, is 340 mm in length, tip of peduncle missing. Colony elongate, slender, curved. Rachis expands gradually toward distal end, which is obtuse and knob-like. Autozooids 10–15 mm long, *c.* 50 in number, in two longitudinal rows along the concave face of the rachis. Convex side of rachis is free of autozooids but is quite rough and has a granular appearance due to the presence of the spiculated calyces of numerous siphonozooids. These zooids are also found at the base of the autozooids. Colony densely spiculated throughout.

Sclerites are tuberculated three-flanged spindles varying in length from 0,1 mm to 0,6 mm. The longer sclerites from the polyps and rachis are tuberculate only at the ends. The shorter spindles of the peduncle may have tubercles throughout the entire length but mostly concentrated at the ends. Tubercles rounded and prominent. The appearance, size, and distribution of these sclerites agrees with those figured by Kükenthal & Broch (1911: 228) for the species.

Colour in alcohol is brownish-grey.

Distribution (Fig. 40)

Atlantic Ocean from the Norwegian Sea to Namibia, and at scattered locations in the Pacific. In southern Africa it is known only from off the Skeleton

Coast of Namibia (450–650 m). This study establishes a new record for southern Africa. The type locality is the Grand Banks, south-east of Newfoundland.

Remarks

The form of the sclerites of this specimen agrees with those figured by Kükenthal & Broch (1911: 228). They are slender and many have knobby protuberances at each end. *Kophobelemnon heterospinosum* Kükenthal, 1910, has similarly shaped sclerites but without prominent tuberculation. *Kophobelemnon affine* Studer, 1894, has tubercles on the peduncular sclerites, but the colonial sclerites as a whole are more stout, being proportionally wider than those of *K. stelliferum*.

Kophobelemnon stelliferum is distinguished from other southern African sea pens by its elongate clavate appearance with rachis that gradually widens distally, 20–40 polyps arranged biserially, and peduncular sclerites that are rods with knobby tubercles.

Kophobelemnon sp.

Fig. 38

Remarks

A 50-mm long colony, possessing only two antozooids, has recently been collected from off Durban, Natal, at 820 m in depth. Four species are characterized by having a reduced number of autozooids: *Kophobelemnon hispidum* Nutting, 1912; *K. pauciflorum* Hickson, 1916; *K. molanderi* Pasternak, 1975*b* nom. nov. (= *K. pauciflorum* Molander, 1929); and *K. macrospinosum* J. A. Thomson, 1927 (= *K. biflorum* Pasternak, 1960). The unavailability of pertinent literature sources precluded the making of necessary comparisons.

Family **Anthoptilidae** Kölliker, 1880

Colonies long and whip-like, bilaterally symmetrical with polyps in two longitudinal series. Polyps in oblique rows, non-retractile, calyces absent. Siphonozooids are numerous on the rachis situated between the oblique rows of autozooids. Sclerites are absent except for minute ovals of the stalk interior. Axis present; round to somewhat quadrangular in cross section. Peduncle stout to robust, not more than one-fifth total colony length.

A monogeneric family of the Atlantic Ocean and Arctic region 238–2 744 m.

Genus *Anthoptilum* Kölliker, 1880

Virgularia (*non* Lamarck, 1816) Verrill, 1879: 239.
Anthoptilum Kölliker, 1880: 13. Jungersen, 1904: 65. Kükenthal & Broch, 1911: 232. Kükenthal, 1915: 32 (Lit!). Hickson, 1916: 138. Grasshoff, 1982*b*: 954.
Benthoptilum Verrill, 1885: 510.
Stephanoptilum Roule, 1905: 455.
Thesioides J. A. Thomson & Henderson, 1906: 91.

Diagnosis

The characters of the family.

Two species of the Atlantic and Arctic.

Type species. Virgularia grandiflora Verrill, 1879; northern Atlantic.

Anthoptilum grandiflorum (Verrill, 1879)

Figs 17, 40

Virgularia grandiflora Verrill, 1879: 239.
Anthoptilum thomsoni Kölliker, 1880: 13, pl. 4 (figs 16–18). J. A. Thomson & Rennet, 1927: 123.
Anthoptilum grandiflorum: Jungersen, 1904: 66. Hickson, 1904: 233, pl. 8 (fig. 14). Kükenthal & Broch, 1911: 233, pl. 14 (figs 5–7), pl. 19 (figs 44–46) (*partim*). J. S. Thomson, 1915: 17. Kükenthal, 1915: 32, fig. 44 (*partim*) (Lit!). Tixier-Durivault, 1954: 629. Grasshoff, 1982*a*: 741, 750; 1982*b*: 954, fig. 35 (Lit!).
Anthoptilum sertum: Kükenthal, 1915: 33.

Material

SAM–H1213, off Lion's Head, Cape Peninsula (33°55′S 17°55′E), 313 m, 16 March 1900, 2 colonies, large dredge, S.S. *Pieter Faure* survey, station PF 2156.

Description

Colonies examined are 400–1 050 mm in length. Polyps 5–10 per row, 8–25 mm in length. Adjacent polyps may be joined proximally, forming a common base for an entire oblique row, or only two or three polyps in a row may be joined, this group being free from the rest of the polyps in the row. Colour often bright red in life, yellowish brown in alcohol.

Distribution (Fig. 40)

In southern Africa, known from off the west coast of the Cape Peninsula, at 238–348 m. The species is also recorded from the western, eastern, and southern Atlantic, as well as the Arctic region. Recorded depth range is 238–2 500 m.

Remarks

This species is distinguished from other southern African pennatulaceans by its whip-like appearance, lack of calyces and sclerites, and with adjacent polyps united at their bases into groups of 5–10 polyps forming short oblique rows.

Family **Funiculinidae** Gray, 1870

Elongate, whip-like colonies with polyps arranged biserially, often covering the lateral and ventral surfaces of the rachis. Polyps are retractile into tubular, eight-toothed calyces, which may be arranged irregularly or in somewhat oblique rows. Siphonozooids few. Sclerites numerous; three-flanged spindles, rods, and ovoid plates.

A monogeneric family of cosmopolitan distribution.

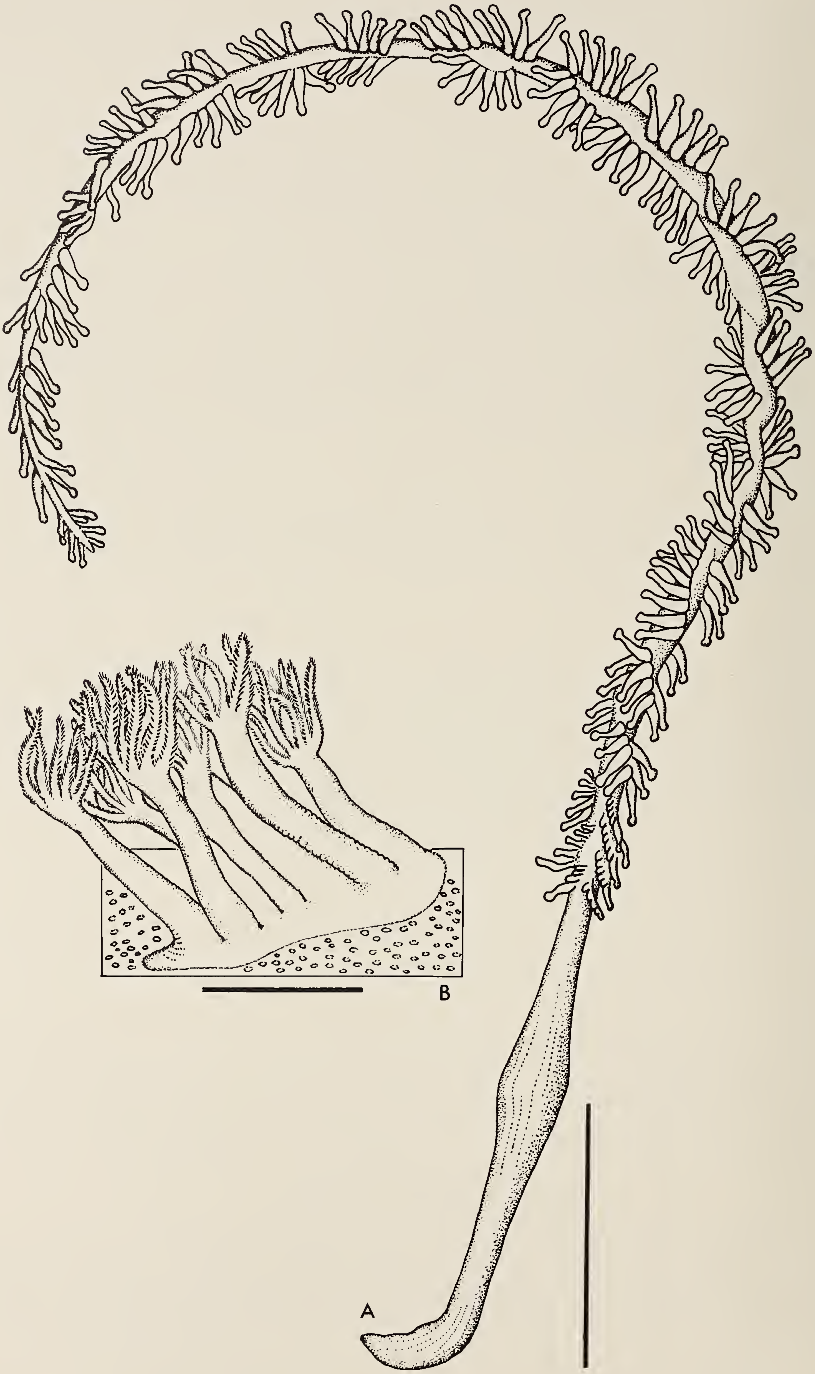

Fig. 17. *Anthoptilum grandiflorum.* A. Entire colony. Scale = 50 mm. B. Detail of group of autozooids with numerous siphonozooids at base. Scale = 10 mm.

Genus *Funiculina* Lamarck, 1816

Funiculina Lamarck, 1816: 422. Herklots, 1858: 8. Kölliker, 1872: 250. Kükenthal & Broch, 1911: 241. Kükenthal, 1915: 34 (Lit!). Manuel, 1981: 53.
Leptoptilum Kölliker, 1880: 27.
Trichoptilum Kölliker, 1880: 29.

Diagnosis

The characters of the family.

Three species are recognized worldwide.

Type species. Pennatula quadrangularis Pallas, 1766.

Funiculina quadrangularis (Pallas, 1766)

Fig. 38

Pennatula quadrangularis Pallas, 1766: 372.
Funiculina quadrangularis Jungersen, 1904: 49. Kükenthal & Broch, 1911: 243, pl. 15 (fig. 12) (Lit.!). Kükenthal, 1915: 34, figs 45–46. J. S. Thomson, 1915: 15, figs 45–46. Pasternak, 1975*b*: 104. Manuel, 1981: 53, fig. 14. Grasshoff, 1981: 227.

Material

Material was not available for examination.

Distribution (Fig. 38)

Cosmopolitan, recorded up to 2 300 m in depth.

Remarks

Thomson (1915: 15) recorded one 490-mm specimen from 146–183 m off Cape Vidal, Natal (28°10′S 32°40′E). According to Manuel (1981: 53), Kükenthal (1915: 34), and the above reference, the species is characterized by having a distinctly quadrangular axis covered with a thin coenenchyme. Colonies may reach 2 199 mm in length. Distal portions of colonies are flexible and often tend to curve or coil spirally. Peduncular interior with ovoid plate-like sclerites. Calyces with elongate, three-flanged spindles (up to 0,63 mm in length) forming eight, pointed terminal teeth and a transverse band of similar sclerites surrounding the base of the teeth. The surface of the rachis possesses three-flanged rod-like sclerites.

Family **Protoptilidae** Kölliker, 1872

Colonies elongate, slender, bilateral. Autozooids arranged in one to three longitudinal series, retractile into spiculate calyces. Sclerites are numerous, three-flanged, mostly spindles. Axis prominent and rounded in cross-section.

Three genera of the Atlantic and Indo-Pacific: *Protoptilum* Kölliker, 1872*a*; *Distichoptilum* Verrill, 1882, and *Helicoptilum* Nutting, 1912. The present study represents the first records of the family for southern Africa.

Genus *Distichoptilum* Verrill, 1882

Distichoptilum Verrill, 1882: 362. Kükenthal, 1915: 39. Hickson, 1916: 101.
Juncoptilum J. A. Thomson & Henderson, 1905: 555.

Diagnosis

Polyps arranged in two longitudinal series. No polyps on ventral surface. Axial side of calyces appressed to lateral margin of rachis. The siphonozooids are two per autozooid, placed on the rachis directly above the mouth of each autozooid, one on the dorsal side and one on the ventral side of the calyx.

A monospecific genus.

Type species. *Distichoptilum gracile* Verrill, 1882; eastern North America.

Distichoptilum gracile Verrill, 1882

Figs 18, 19H–I, 40

Distichoptilum gracile Verrill, 1882: 362. Jungersen, 1904: 62. J. A. Thomson & Henderson, 1906: 87. Kükenthal, 1915: 39 (Lit.!). Pasternak, 1975*b*: 106. Grasshoff, 1982*a*: 738, 741–742, map 8; 1982*b*: 955, figs 38–39.
Juncoptilum Alcocki J. A. Thomson & Henderson, 1905: 555.

Material

SAM–H3163, west of Table Bay, western Cape Province (33°49′S 16°30′E), 2 744 m, 27 August 1959; many fragments of several colonies, 15-foot beam trawl, Division of Sea Fisheries.

Description

Colonies examined are perhaps up to 1 000 mm in length and 4 mm in width. Polyps in two longitudinal series, alternate or sub-opposite, retractile into prominent calyces. Distance between polyps along rachis 4–7 mm. Calyces 2–4 mm long. Calyces adhere to rachis along their inner proximal portions and face upward. Calyces usually with two terminal teeth, but these are sometimes obscure in autozooids of the lower rachis. Sclerites of the calyces are large spindles (up to 0,5 mm in length), three-flanged and smooth. Peduncular sclerites are shorter and inconspicuously three-flanged. Calyces orange, rachis yellowish to cream.

Distribution (Fig. 40)

Previously recorded from the eastern Pacific, Indian, and northern Atlantic Oceans, 793–4 300 m. This work represents the first record of the genus and species in southern Africa, and extends the range in the Atlantic southward from Europe and eastern North America.

Remarks

A considerable amount of variation is evident in this species. Kükenthal (1915: 40) stated that the calyces possess six terminal teeth and the length of calyx sclerites is up to 1,0 mm. Jungersen (1904: 62) regarded number of calyx teeth as

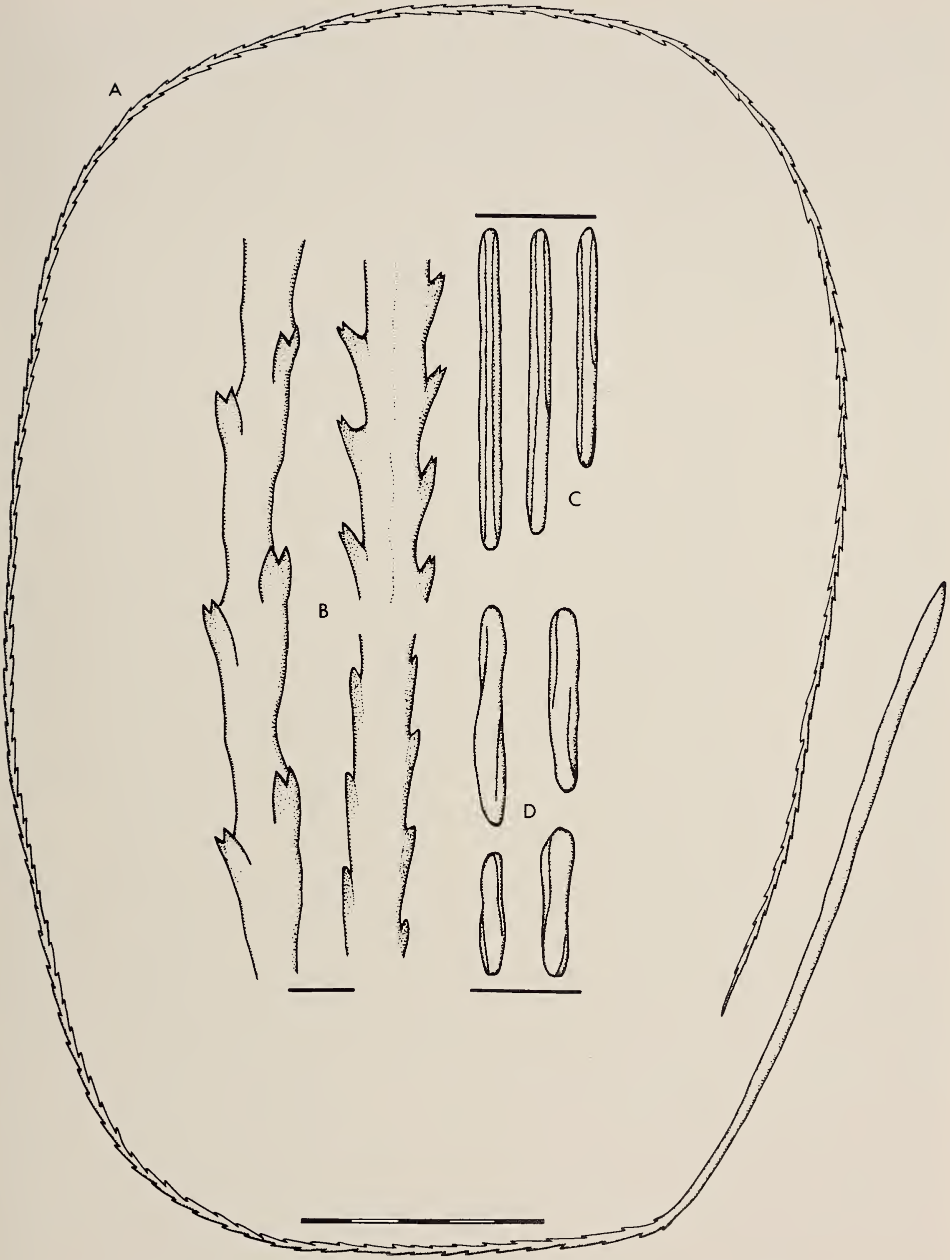

Fig. 18. *Distichoptilum gracile*. A. Entire colony. Scale = 50 mm. B. Detail of colony from three different parts of rachis showing calyces. Scale = 2 mm. C. Sclerites from calyx. Scale = 0,2 mm. D. Sclerites from peduncle. Scale = 0,1 mm.

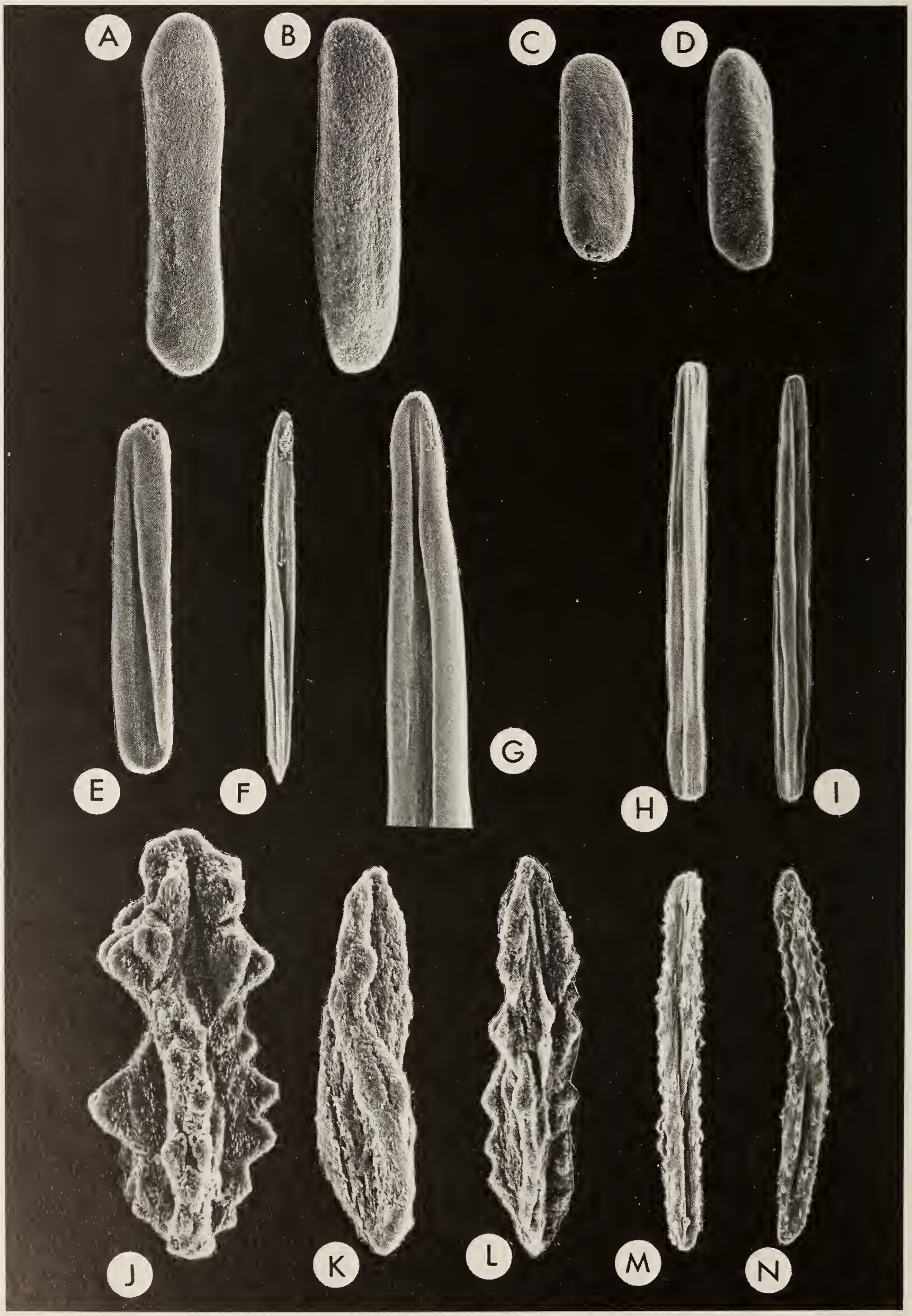

Fig. 19. Scanning electron micrographs of sclerites. A–G. *Halipteris africana*. A–D. From peduncle: 0,07 mm; 0,05 mm; 0,04 mm. E. From tentacle: 0,11 mm. F. From calyx: 0,58 mm. G. Tip of calyx sclerite: 0,2 mm. H–I. *Distichoptilum gracile*. From calyx: 0,36 mm; 0,44 mm. J–N. *Umbellula thomsoni*. J–L. From anthocodial neck zone: 0,05 mm; 0,05 mm; 0,06 mm. M–N. From tentacle: 0,2 mm; 0,24 mm.

a matter of the degree of contraction of the polyps, as some highly contracted polyps show two lobes, whereas partially contracted polyps often exhibit six distinct teeth. He also stated that the length of calyx sclerites varies between 0,528 and 0,800 mm. The calyces of the southern African material show two large teeth only and the sclerites vary from 0,28–0,50 mm in length.

Distichoptilum gracile is distinguished from other southern African sea pens by its thin whip-like appearance, small polyps retractile into permanent calyces that are appressed close to the surface of the rachis and are arranged biserially in two longitudinal rows.

Family **Scleroptilidae** Jungersen, 1904

Polyps usually situated in pairs or groups of three along rachis, separated by intervals of bare rachis. Axis thin and delicate, extending entire length of colony. Siphonozooids few and scattered on rachis. Calyces absent. Sclerites present or absent.

A family of two genera from the North Atlantic and Indo-Pacific.

Genus *Scleroptilum* Kölliker, 1880

Scleroptilum Kölliker, 1880: 30. Balss, 1910: 24. Kükenthal & Broch, 1911: 265. Kükenthal, 1915: 43.

Diagnosis

Sclerites (rods or three-flanged spindles) are present in the walls of the autozooids.

A genus of at least two or three species from the northern Atlantic and Indo-Pacific.

Type species. Scleroptilum grandiflorum Kölliker, 1880; Japan.

Scleroptilum sp.

Fig. 38

Remarks

Five colonies, 35–50 mm in length, have recently been collected from off the Transkei coast at 510 m in depth. These colonies can be assigned to the genus *Scleroptilum* by the arrangement of the polyps in whorls or clusters of 2–3 (each cluster separated by bare areas of rachis), lack of calyces, and the possession of sclerites in the walls of the polyps. The sclerites differ from those of *Scleroptilum grandiflorum* Kölliker, 1880, and the material has not been identified to species. This represents the first record for the family and genus in southern Africa.

Genus *Calibelemnon* Nutting, 1908

Calibelemnon Nutting, 1908: 562. Balss, 1910: 70. Kükenthal, 1915: 44.
Prochunella Balss, 1909: 426.

Diagnosis

Sclerites completely absent or with small bodies restricted to the peduncle.

A genus of perhaps two species of the Indo-Pacific.

Type species. Protocaulon indicum J. A. Thomson & Henderson, 1906; Bay of Bengal.

Calibelemnon sp.

Fig. 38

Remarks

Several colonies were collected in 1975 from near Cape Vidal, Natal, at 740 m in depth. Unlike *Calibelemnon indicum* (J. A. Thomson & Henderson, 1906), in which sclerites are completely absent, these colonies possess small sclerites in the peduncle, and therefore probably represent an undescribed species. This represents a new record of the genus in southern Africa and extends the range to the south-western fringe of the Indo-Pacific region.

Family **Chunellidae** Kükenthal, 1902

Rachis slender. Axis quadrangular. Polyps in well-separated whorls. One to four polyps per whorl. Polyps without calyces. Siphonozooids few and inconspicuous, on rachis between autozooids. Sclerites absent except for minute oval bodies in the interior of the peduncle.

Two genera of the Indian Ocean. The present study represents the first record of the family in southern Africa.

Genus *Chunella* Kükenthal, 1902

Chunella Kükenthal, 1902: 302; 1915: 45. Kükenthal & Broch, 1911: 271.

Diagnosis

With terminal autozooid highly reduced or absent. Whorls with 1–4 autozooids.

A genus of three nominal species, from the eastern coast of Africa to the Malay Archipelago.

Type species. Chunella gracillima Kükenthal, 1902; East Africa.

Chunella gracillima Kükenthal, 1902

Figs 20, 38

Chunella gracillima Kükenthal, 1902: 302; 1915: 45, fig. 53. Kükenthal & Broch, 1911: 272, pl. 15 (fig. 13). Bayer, 1956: 227.

Material

SAM–H3735, off Port Durnford, Natal (28°37,8′S 32°38,4′E), 1 000–1 200 m, 25 May 1976, 8 whole colonies, beam trawl, South African Museum R.V. *Meiring Naude* cruises. SAM–H4029, one whole colony, same data as SAM–H3735.

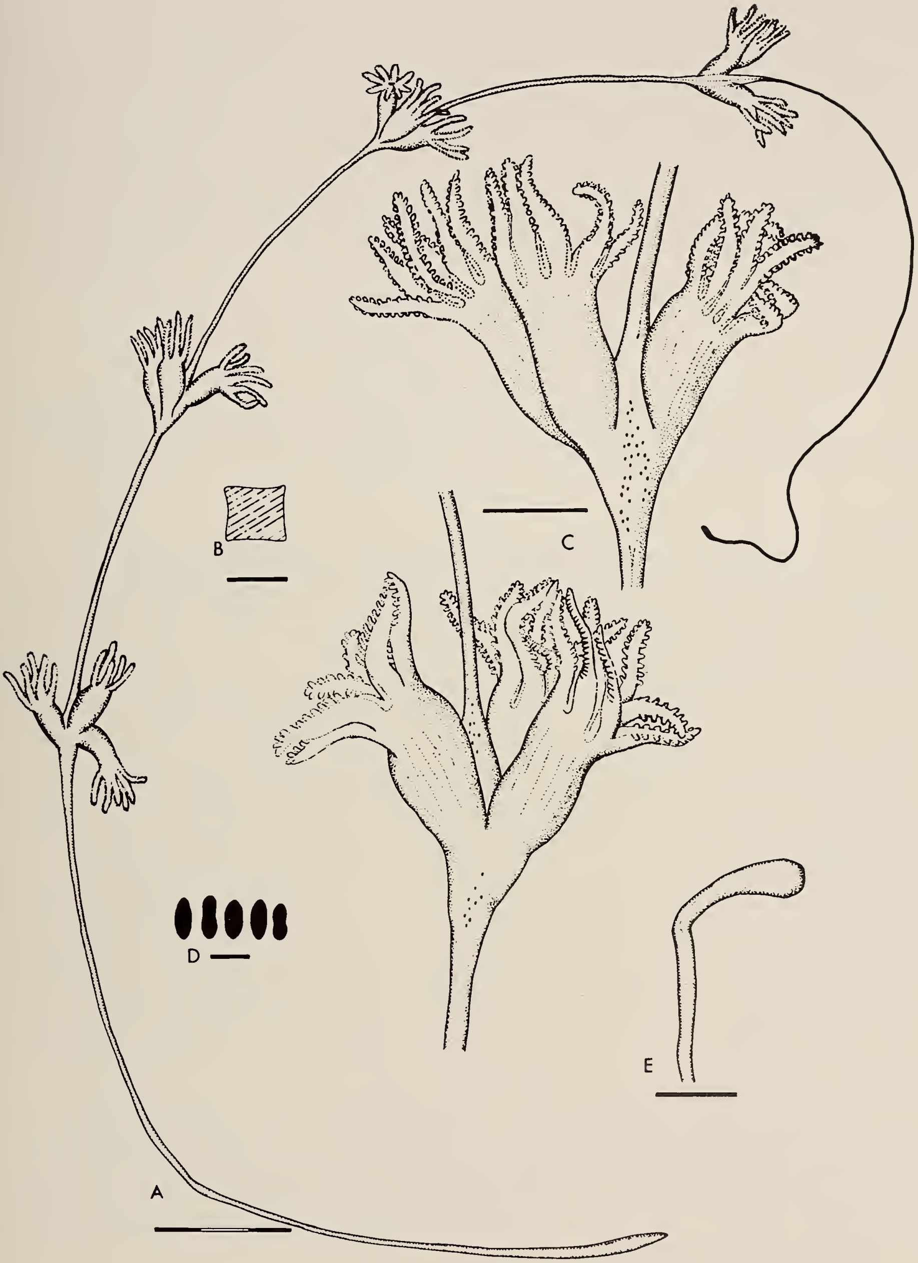

Fig. 20. *Chunella gracillima.* A. Entire colony. Scale = 30 mm. B. Transverse section of axis. Scale = 0,7 mm. C. Two groups of three autozooids with minute siphonozooids on rachis. Scale = 5 mm. D. Minute sclerites from lower peduncle. Scale = 0,02 mm. E. Rudimentary polyp from distal tip of colony. Scale = 1,2 mm.

Description

Colonies examined vary in length from 320–550 mm. Number of autozooids per whorl varies from one to four (most commonly three). Whorls 3–7 per colony separated by 30–60 mm intervals of bare rachis. Autozooids vary from 3 mm to 15 mm in length in a preserved state. Siphonozooids few and inconspicuous on the rachis at each autozooid whorl, consistent in form and size throughout the colony. Axis conspicuously quadrangular, 0,5–1,5 mm in width. Peduncle up to 50 mm in length and 3–4 mm in width. Sclerites absent except for minute oval bodies up to 0,02 mm long in the interior of the lower peduncle of all colonies examined. Autozooids greyish with brown tentacles, rachis and peduncle cream.

Distribution (Fig. 38)

Equatorial eastern Africa and Natal, 818–1 200 m. This is the first record of the genus and species in southern Africa. The type locality is Pemba Island, border of Kenya and Tanzania, 818 m in depth.

Remarks

This species is distinguished from other southern African sea pens by its 3–7 demarcated clusters of 2–4 polyps and possession of a single rudimentary terminal polyp.

Remarks on the genus Chunella

Kükenthal & Broch (1911: 275) described *Chunella quadriflora* for colonies with lower whorls of four autozooids, from the same locality as *C. gracillima*. Hickson (1916) described *C. biflora* (from the Malay Archipelago) for colonies with two autozooids per whorl. Kükenthal (1915: 45) characterized *C. gracillima* as having three autozooids per whorl.

Of the eight colonies from the same trawl sample that I have examined, one has four autozooids in a lower whorl and three in an upper whorl. Another colony has two autozooids in upper whorls and three in lower whorls. Some whorls in other colonies may have one, two, or three autozooids per whorl. It therefore seems that, since the number of autozooids per whorl is not consistent in a given colony, the character can hardly be used to separate species. As a result, I suspect that the three species may in fact be conspecific but the pertinent type material is presently unavailable for comparative examination.

Kükenthal & Broch (1911, pl. 20 (fig. 49)) showed a photograph labelled '*Chunella quadriflora*'. The specimen appears to possess three whorls of two autozooids each and a single well-developed terminal autozooid. The photograph therefore appears to be that of a colony of *Amphiacme abyssorum* and not *Chunella quadriflora*.

Genus *Amphiacme* Kükenthal, 1903

Amphianthus Kükenthal, 1902: 303.
Amphiacme Kükenthal, 1903: 275; 1915: 46. Kükenthal & Broch, 1911: 276.

Diagnosis

With a single terminal autozooid that is well-developed and somewhat asymmetrical. Autozooids in pairs. Siphonozooids present on the keel of the terminal autozooid as well as on the rachis between the individual autozooids of each pair.

A monospecific genus of the eastern African coast.

Type species. Amphianthus abyssorum Kükenthal, 1902; East Africa.

Amphiacme abyssorum (Kükenthal, 1902)

Figs 21, 38

Amphianthus abyssorum Kükenthal, 1902: 302.
Amphiacme abyssorum: Kükenthal, 1903: 275; 1915: 47, fig. 54. Kükenthal & Broch, 1911: 276, pl. 15 (fig. 14). Tixier-Durivault, 1972: 52. Tixier-Durivault & D'Hondt, 1974: 260.

Material

SAM–H3736, off Jesser Point, Natal (27°38,6'S 32°52,6'E), 860 m, 21 May 1976, 1 whole colony, beam trawl, South African Museum R.V. *Meiring Naude* cruises. SAM–H3737, off Port Durnford, Natal (28°37'S 32°38'E), 1 000–1 200 m, 25 May 1976, 2 whole colonies, beam trawl, South African Museum R.V. *Meiring Naude* cruises.

Description

The colonies examined are 230–250 mm in length. Axis conspicuously quadrangular, usually <1 mm in width. Autozooids in two or three pairs along rachis, at intervals of 30–50 mm. Autozooids about 10 mm in length preserved. Terminal autozooid bilaterally symmetrical or somewhat asymmetrical, 8–10 mm long with a ventral keel. Peduncle 10–12 mm in length and 1–2 mm in width. Siphonozooids few, located on the rachis at each whorl and on the keel of terminal autozooid. Sclerites absent except for oval bodies (<0,02 mm) in peduncle. Polyps brownish-grey, rachis cream or tan, peduncle brownish.

Distribution (Fig. 38)

The Indian Ocean coast of Africa, from the equator to Natal, and Madagascar; 760–1 200 m. The present study represents a new record for southern Africa and extends the range of the genus and species south to South Africa. The type locality is the coastal region near the border of Kenya and Tanzania, 818–1 019 m in depth.

Remarks

Amphiacme abyssorum is distinguished from other southern African pennatulaceans by the arrangement of the polyps in two or three demarcated pairs along the rachis, and the possession of a single modified terminal polyp.

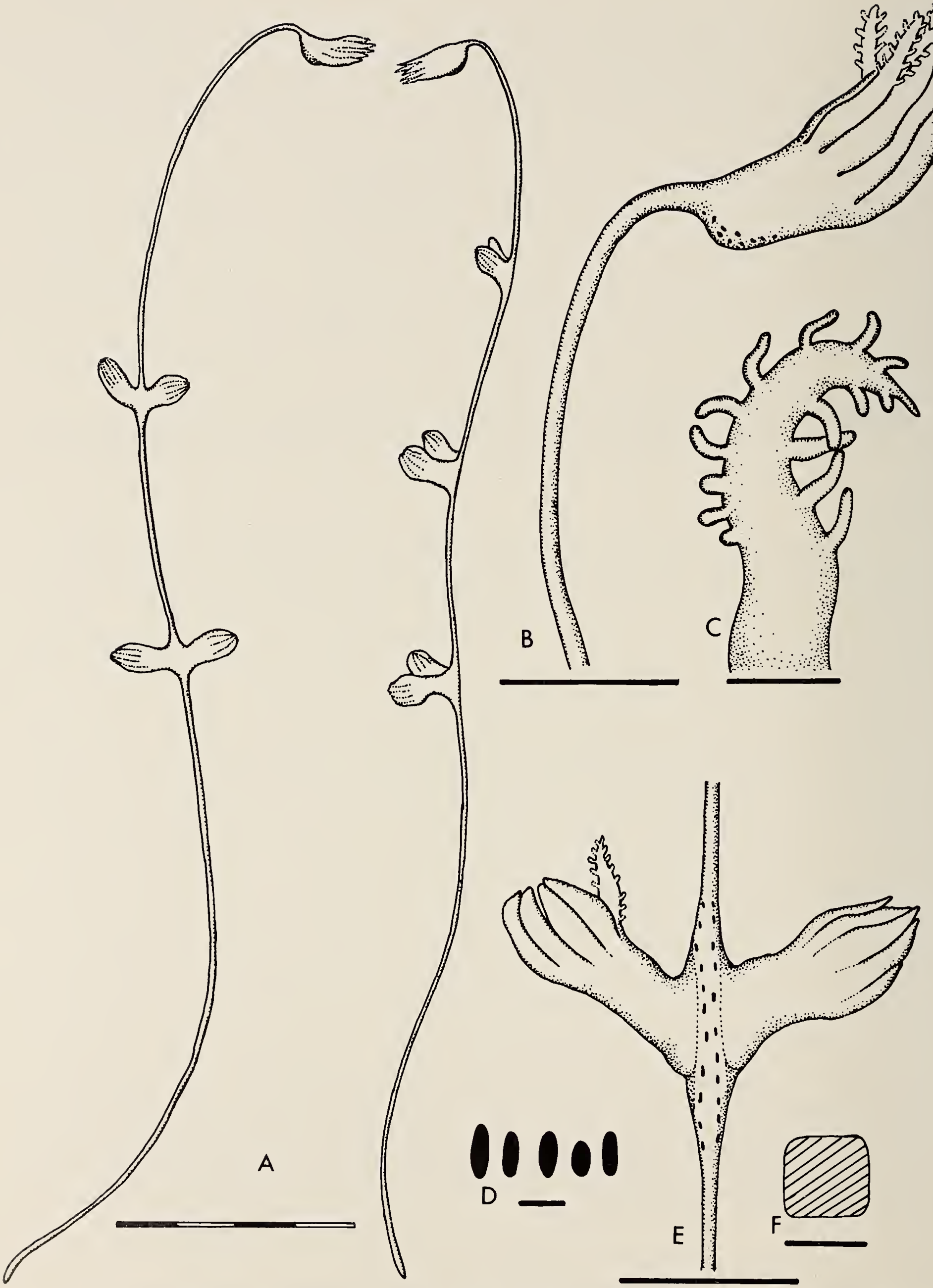

Fig. 21. *Amphiacme abyssorum*. A. Two entire colonies. Scale = 40 mm. B. Terminal autozooid with ten minute siphonozooids on keel. Scale = 10 mm. C. Single tentacle from autozooid. Scale = 1 mm. D. Sclerites from peduncle. Scale = 0,02 mm. E. Detail of rachis with a pair of autozooids and several siphonozooids. Scale = 10 mm. F. Transverse section of axis. Scale = 0,5 mm.

Family **Umbellulidae** Lindahl, 1874

Rachis long and slender. Axis quadrangular to round in cross section. Autozooids restricted to the distal terminus, usually forming an umbellate cluster. Siphonozooids are present on the rachis at the base of the autozooids or on bare parts of the rachis. Sclerites present in peduncle and terminal cluster, or totally absent. When present, sclerites are rods, spindles or needles, three-flanged round in cross-section.

A monogeneric family.

Genus *Umbellula* Cuvier, 1798

Isis Linnaeus, 1758: 800 (*partim*).
Pennatula Pallas, 1766: 335 (*partim*).
Vorticella Linnaeus, 1767: 1317.
Ombellula Cuvier, 1798: 675.
Umbellularia Lamarck, 1816: 436. Kölliker, 1872*a*: 203.
Umbellula Gray, 1870: 39. Kölliker, 1875: 11. Kükenthal & Broch, 1911: 282 (Lit!). Broch, 1957: 350; 1958*a*: 267; 1958*b*: 251. Grasshoff, 1982*b*: 956.

Diagnosis

Characters of the family.

A genus of perhaps 12 valid species. Cosmopolitan distribution; deep sea, 250 m to over 6 100 m.

Type species. Isis encrinus Linnaeus, 1758; Arctic Ocean.

Umbellula thomsoni (Kölliker, 1874)

Figs 19J–N, 22, 23, 40

Umbellularia Thomsonii Kölliker, 1874: 13.
Umbellula Thomsonii: Kölliker, 1875: 11.
Umbellula thomsonii: Broch, 1958: 253, figs 2, 4 (Lit!). Grasshoff, 1972: 2, fig. 1.
Umbellula Guntheri Broch, 1913: 3, pl. 1 (fig. 1).
Umbellula aciculifera J. S. Thomson, 1915: 20 (and text-fig. on p. 21), pl. 2 (figs 1–2).
Umbellula thomsoni: Kölliker, 1880: 19. Kükenthal, 1915: 54. Pasternak, 1970: 240, fig. 2; 1975*b*: 106. Grasshoff, 1982*a*: 753, map 11; 1982*b*: 958.

Material

SAM–H1166, south-west of Cape Point (34°40′S 17°45′E), 1 650 m, 21 July 1903, 1 colony, shrimp trawl, S.S. *Pieter Faure* survey, station PF 17026. (Holotype of *Umbellula aciculifera* Thomson, 1915.)

Description

The colony examined is about 475 mm in length. The axis is 3 mm in diameter, rounded quadrangular near the terminal cluster. Umbellate cluster composed of 10 autozooids, each 15–20 mm long. Sclerites conspicuous and numerous. Terminal end of rachis, polyp walls, and proximal portions of tentacles with knobby, three-flanged rods and spindles (<0,3 mm). Aboral surface of tentacles and pinnules with spindles (0,5–1,3 mm); round in cross-section, not

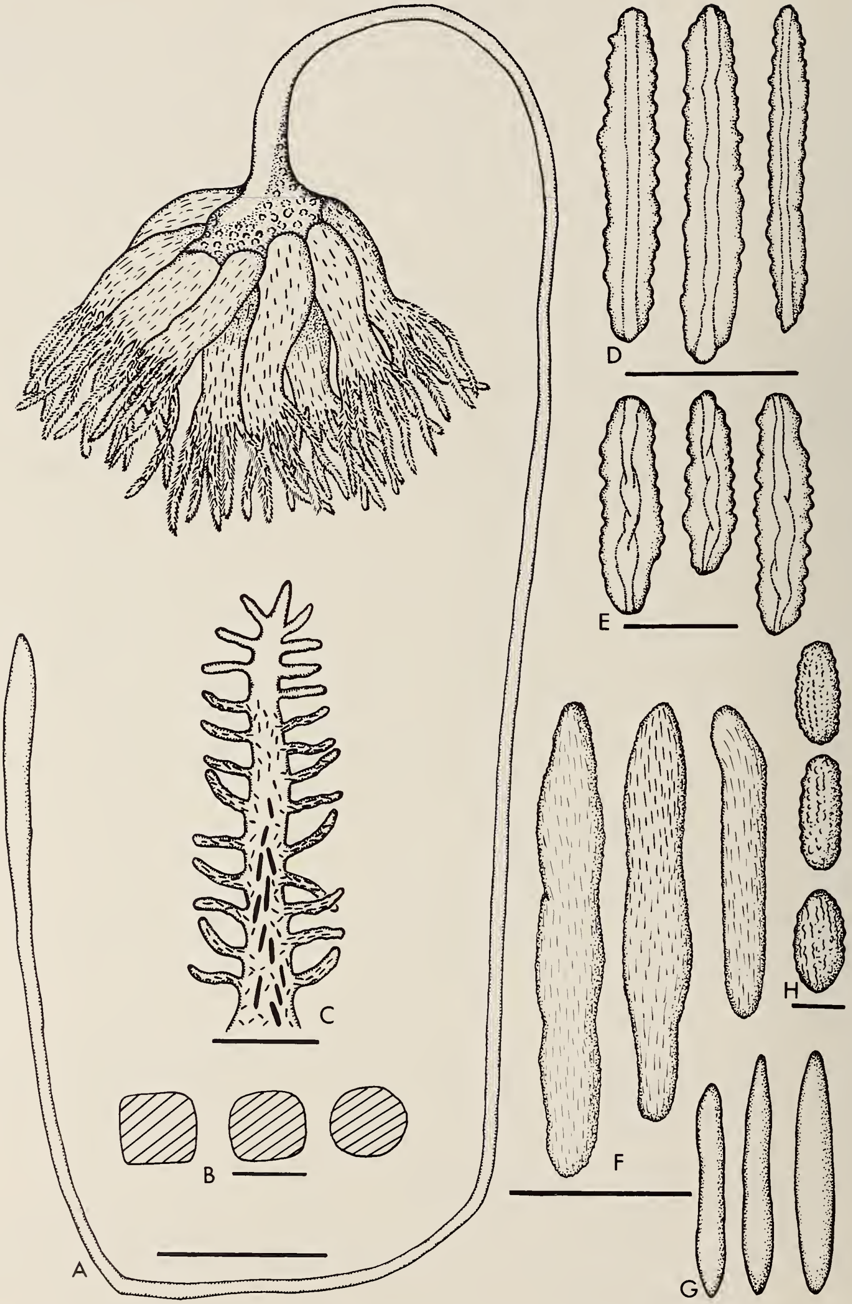

Fig. 22. *Umbellula thomsoni*. A. Entire colony. Scale = 20 mm. B. Transverse sections through three different areas of axis. Scale = 2 mm. C. Single tentacle. Scale = 3 mm. D. Small sclerites from proximal portion of tentacle. Scale = 0,1 mm. E. Sclerites from body wall of autozooid. Scale = 0.02 mm. F. Large sclerites from proximal portion of tentacle. G. Sclerites from pinnule. F–G. Scale = 0,5 mm. H. Sclerites from peduncle. Scale = 0,04 mm.

three-flanged. Peduncle with rough ovals or rods (0,08–0,11 mm in length), having numerous low, rounded knobs or tubercles.

Distribution (Fig. 40)

Apparently cosmopolitan, 1 300–6 200m. This specimen is the only known southern African record, first described by J. S. Thomson (1915) as *Umbellula aciculifera* (type specimen). The type locality of *U. thomsoni* is the north Atlantic.

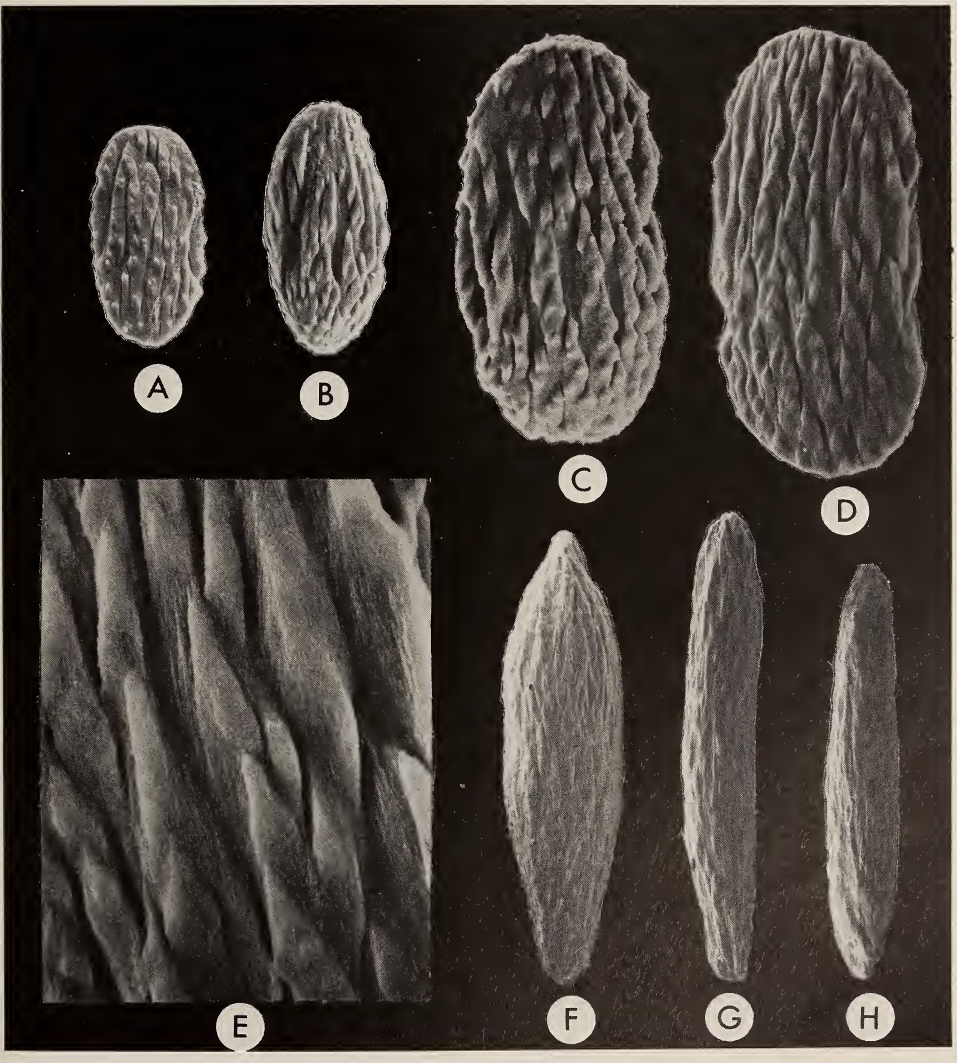

Fig. 23. Scanning electron micrographs of sclerites of *Umbellula thomsoni*. A–D. From peduncle: 0,08 mm; 0,09 mm; 0,1 mm; 0,11 mm. E. Detail of surface of D; length of micrograph 0,04 mm. F–H. Large sclerites from tentacle: 0,7 mm; 0,8 mm; 0,7mm.

Remarks

The colony has five solitary epizoic zooanthids (species indeterminate) attached to bare areas of the upper rachis. They vary from 5–15 mm in diameter and 10–12 mm in length (zooanthids not shown in Fig. 22A).

This species is distinguished from other southern African sea pens by having the autozooids restricted to a cluster at the distal end of an elongate colony, and the possession of sclerites in the autozooids.

Umbellula lindahli Kölliker, 1874

Figs 24, 40

Umbellula lindahlii Kölliker, 1874: 12. Jungersen, 1904: 75, pl. 3 (figs 37–46). Kükenthal, 1915: 48.
Umbellula miniacea Lindahl, 1874: 12, pls 1–2.
Umbellula pallida Lindahl, 1874: 13, pl. 3.
Umbellula lindahli: Broch, 1958: 262 (Lit.!). Grasshoff, 1982*a*: 741–742, 753; 1982*b*: 958, fig. 43. Pasternak, 1975*b*: 109.

Material

SAM–H3738, off the Cape of Good Hope Peninsula (34°37′S 17°03′E), 2 890–2 963 m, 8 December 1959, 2 colonies, beam trawl, Division of Sea Fisheries Survey, station A315. SAM–H3739, west of Dassen Island, western Cape Province (33°36′S 16°15′E), 2 780–2 872 m, 26 August 1959, 2 colonies, beam trawl, Division of Sea Fisheries Survey. SAM–H4028, south of False Bay (35°22,3′S 18°45,4′E), 490 m, 6 July 1986, 22 colonies, beam trawl, Rob Lesley (Sea Fisheries Research Institute, West Coast Biomass Survey, station A4305046).

Description

Colonies examined are 770–900 mm in length. Axis conspicuously quadrangular, 1–2 mm in width. Peduncle up to 150 mm long by 6 mm in width. Umbellate terminal cluster with 8–10 autozooids, each 20–30 mm long. Siphonozooids numerous on keel-like terminus of rachis. Sclerites totally absent.

Distribution (Fig. 40)

Cosmopolitan up to 6 100 m in depth. In southern Africa, the species is presently known only from the south-western Cape (490–2 963 m). This study represents a new record of the species to southern Africa. The type locality is the Arctic region of Greenland.

Remarks

This species is differentiated from other southern African sea pens by the restriction of the autozooids to a cluster at the terminal end of an elongate colony, and the complete absence of sclerites.

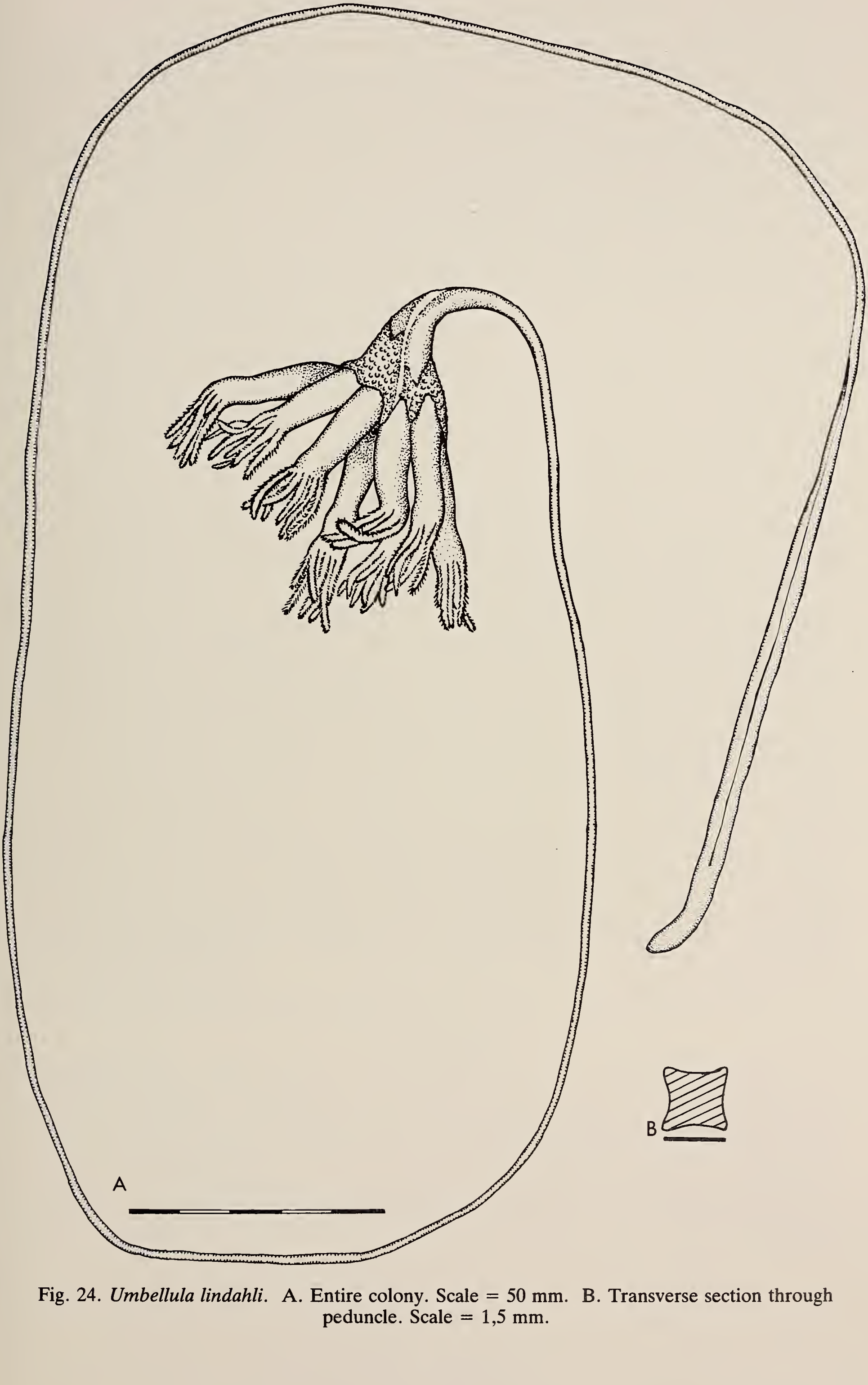

Fig. 24. *Umbellula lindahli.* A. Entire colony. Scale = 50 mm. B. Transverse section through peduncle. Scale = 1,5 mm.

Remarks on the genus Umbellula

Grasshoff (1972) recognized three species of the genus that have sclerites in the terminal autozooid region. *Umbellula monocephalus* Pasternak, 1964 (jun. syn. *U. thieli* Grasshoff, 1972) has only a single autozooid; the other two species both have multiple autozooids—*U. durissima* Kölliker, 1880, has both axis and sclerites that are round in cross section, whereas *U. thomsoni* has three-flanged sclerites and a quadrangular axis. I have found that shape of the axis in cross-section is an invalid differentiating character with regards to *U. thomsoni*, since different parts of the axis of the colony examined (SAM–H1166) are round or rounded quadrangular, but never sharply quadrangular (Fig. 22B). Also, the large sclerites of the tentacles and pinnules (>0,5 mm) are round in cross-section, whereas the small sclerites (<0,3 mm) of the proximal regions of the tentacles and of the entire polyp body wall are conspicuously three-flanged (Figs 19J–N, 22D–E, 23F–H). Thus, this specimen (which is the type upon which the des-cription of *U. aciculifera* Thomson, 1915, was based) possesses characteristics intermediate between *U. durissima* and *U. thomsoni*. In addition, Grasshoff (1972, fig. 2B) showed three-flanged spindles from the polyp walls of *U. durissima*. These facts tend to negate distinctions between the two species. Examination of type material and a variety of specimens is necessary to determine if we are dealing with two distinct species or a single variable one. This material is presently unavailable to me for comparison.

Broch (1958*b*) revised the genus *Umbellula* and recognized five species without sclerites in the terminal cluster. *Umbellula hemigymna* Pasternak, 1975*a*, was subsequently added from the Caribbean Sea. Of these six, *U. lindahli* is characterized by having quadrangular axis, large autozooids on a tassel not especially crowded, and full-grown colonies >400 mm in length. Broch (1961) compared specimens of *U. encrinus* (Linnaeus, 1758) with those of *U. lindahli* and considered them conspecific, thereby making the latter a junior synonym of *U. encrinus*. Subsequent workers, including Pasternak (1961*b*, 1964, 1975*b*, 1980) and Grasshoff (1982*a*, 1982*b*), did not recognize this synonymy and considered the two species as distinct. I have retained this distinction here. Grasshoff (1982*b*: 957–958) distinguished the two species as follows: *U. encrinus*—stalk thick, polyps stocky; *U. lindahli*—stalk thin, polyps slender.

Family **Virgulariidae** Verrill, 1868

Colonies bilateral, long and slender to whip-like. Axis well-developed, present throughout length of colony. Adjacent autozooids fused proximally, forming polyp leaves or low ridges that are arranged in transverse or oblique rows along rachis. Sclerites three-flanged spindles, minute plates, or entirely absent.

The family is of cosmopolitan distribution, with two subfamilies and six genera.

Subfamily Virgulariinae Verrill, 1868

Autozooids form low to well-developed polyp leaves (flattened expansions) by fusion of their proximal portions.

Five genera, two of which are included below, in addition to *Acanthoptilum* Kölliker, 1870, *Scytalium* Herklots, 1858, and *Stylatula* Verrill, 1864.

Genus *Virgularia* Lamarck, 1816

Virgularia Lamarck, 1816: 429. Kükenthal & Broch, 1911: 323. Kükenthal, 1915: 71 (Lit!).
Lygus Herklots, 1858: 11.
Halisceptrum Herklots, 1863: 33.
Sceptonidium Richiardi, 1869: 63.
Cladiscus Koren & Danielssen, 1877: 101.
Protocaulon Kölliker, 1880: 26.
Svava Danielssen & Koren, 1884: 57.
Deutocaulon Marshall & Fowler, 1888: 453.
Svavopsis Roule, 1908: 181.

Diagnosis

Colonies long and slender, often vermiform. Peduncle and rachis usually abruptly delimited. Autozooids form polyp leaves that are arranged in two longitudinal series along rachis. Autozooids retractile into fleshy calyces. Siphonozooids are present on polyp leaves below the free parts of the autozooids or on the rachis between the polyp leaves. Sclerites absent except for minute ovals and plates of the peduncle interior. Axis present throughout entire length of rachis and upper portion of peduncle, often projecting beyond apex of rachis.

A genus of about 20 species, in need of revision. Cosmopolitan.

Type species. Pennatula mirabilis Linnaeus, 1758; North Atlantic.

Virgularia schultzei Kükenthal, 1910

Figs 1D–F, 25, 28C–D, 41

Virgularia schultzei Kükenthal, 1910: 53; 1915: 72, figs 72, 73 (Lit.!). Kükenthal & Broch, 1911: 326, figs 124–125, pl. 17 (figs 21–22). J. S. Thomson, 1915: 16. Broch, 1939: 30. Tixier-Durivault, 1954: 630.
Virgularia Reinwardti (*non* Herklots, 1858) Hickson, 1900: 87. Balss, 1910: 47 (*partim*).
Virgularia spec. (juv.) Broch, 1910: 231.

Material

SAM–H3387, off Danger Point, Cape Province (34°37′S 19°24′E), 19 m, 11 April 1984, 11 colonies, SCUBA, W. R. Liltved. SAM–H3159, off Koeberg Power Station, western Cape Province (33°40′S 18°26′E), 6–20 m, 24–26 November 1981, 8 colonies, SCUBA, W. R. Liltved. SAM–H3338, Algoa Bay, eastern Cape Province (33°50′S 25°40′E), 16 m, 17 May 1984, 1 colony, SCUBA, G. C. Williams.

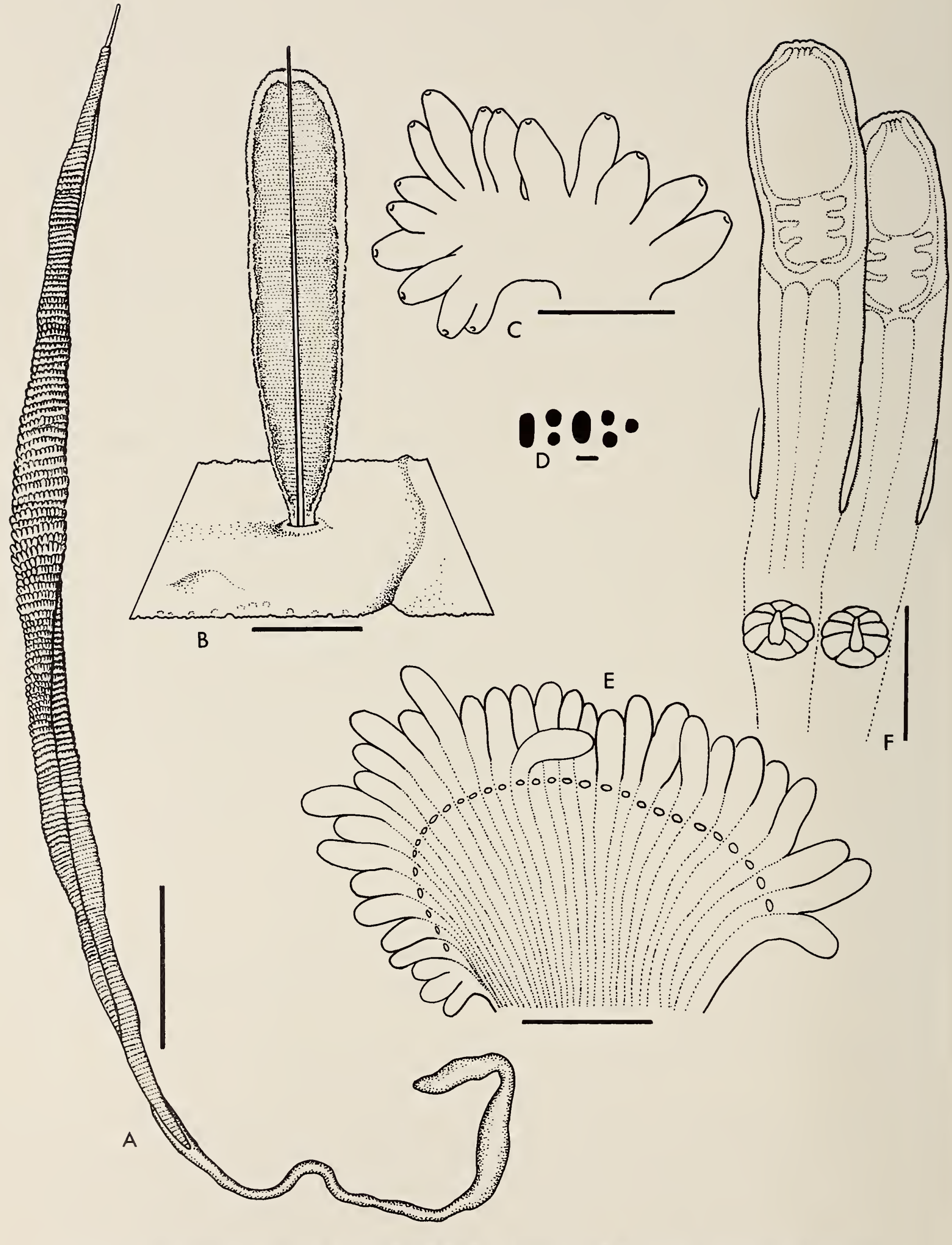

Fig. 25. *Virgularia schultzei.* A. Entire preserved colony. Scale = 20 mm. B. Expanded colony *in situ*. Scale = 20 mm. C. Polyp leaf from a 120 mm long colony. Scale = 1 mm. D. Peduncle sclerites. Scale = 0,005 mm. E. Lower surface of a polyp leaf from middle of rachis of a 400-mm long colony. Scale = 2 mm. F. Two retracted polyps from a polyp leaf showing siphonozooids at base. Scale = 0,5 mm.

Description

Colonies examined ranged in length from 85–500 mm, and 5–12 mm in width. Peduncle long and flexible. Axis up to 1,5 mm in diameter, round in cross-section. Surface of axis often with numerous perforations (canals of Kölliker) 0,003–0,004 mm in diameter. Polyp leaves well developed, numerous, transparent. Autozooids 15–35 per polyp leaf. Siphonozooids are present on the lower surface of the polyp leaves, usually one per autozooid in a band below the calyx-like free portions of the autozooids. Sclerites absent except for minute ovals of the peduncle interior (*c.* 0,005 mm in length). Colour variable, cream or white to yellowish or orange; uniformly coloured or distinctly mottled.

Distribution (Fig. 41)

Apparently endemic to southern Africa, from Lüderitz Bay, Namibia, to at least as far as Kosi Bay, littoral to 222 m in depth. Day (1974*b*: 35) listed the species from Inhambane, Mozambique. This species is one of the most frequently encountered sea pens in South Africa.

Observations

SCUBA divers have observed this species with patchy or localized distribution and high population density. An extensive patch about 50 m in depth off Hout Bay, Cape Peninsula, has numerous colonies that are spaced relatively uniformly (about 0,5 m apart) in what appears to be a relatively regular pattern of spacing (P. A. Hulley pers. comm.).

Remarks

Virgularia schultzei is distinguished from other southern African species of *Virgularia* by having siphonozooids on the lower surfaces of the polyp leaves, below the free distal ends of the autozooids, and 15–35 autozooids per polyp leaf.

Virgularia mirabilis (Linnaeus, 1758)

Figs 26, 41

Pennatula mirabilis: Linnaeus, 1758: 819. Müller, 1776: 255.
Virgularia mirabilis Lamarck, 1816: 431. Kükenthal & Broch, 1911: 329, fig. 126. Kükenthal, 1915: 73, fig. 76 (Lit.!). Manuel, 1981: 54, fig. 15. Tixier-Durivault, 1961*b*: 254, figs 17–18; 1963: 72. Tixier-Durivault & D'Hondt, 1974: 262.

Material

SAM–H3240, mouth of False Bay, western Cape Province (34°22,7′S 18°43,1′E), 78 m, 10 September 1953, 1 colony, dredge, University of Cape Town Ecological Survey. SAM–H3746, off Stony Point, Transkei (32°38,9′S 28°45,0′E), 360 m , 17 July 1984, 1 partial colony, dredge; G. C. Williams, R.V. *Meiring Naude*. SAM–H3869, 67 km west of Cape Fria, Namibia (18°25′S 11°15′E), 274 m, May–June 1982, many colonies, trawl.

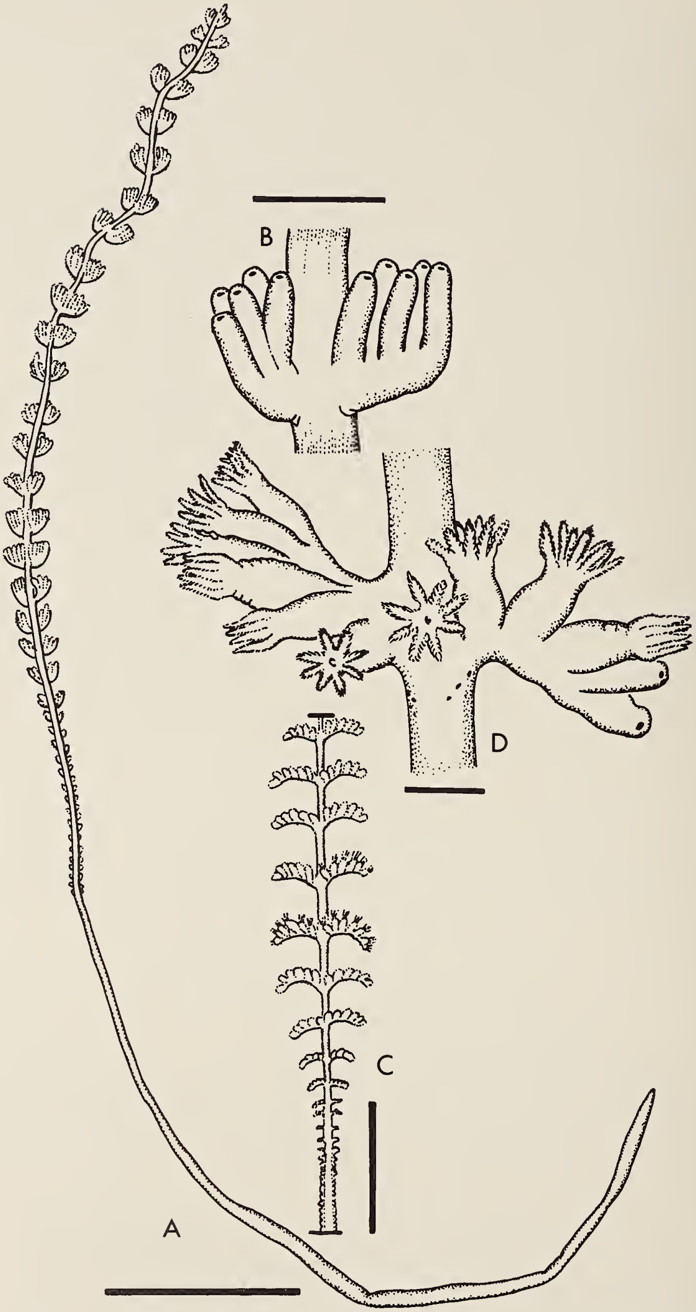

Fig. 26. *Virgularia mirabilis*. A. Entire colony. Scale = 10 mm. B. Detail of rachis with retracted polyps. Scale = 1 mm. C. Part of rachis from colony with expanded polyps. Scale = 10 mm. D. Detail of rachis showing expanded polyps. Scale = 1 mm.

Description

The colonies examined are up to 95 mm long, vermiform, very slender and delicate. Polyp leaves small and not crowded. Autozooids 5–12 per polyp leaf. Autozooids globular or long and narrow, about 1,0 mm long and 0,2 mm wide. Siphonozooids inconspicuous on the sides of the rachis below the polyp leaves and do extend on to the dorsal surface of the rachis. Peduncle about as long as rachis. Sclerites absent except for minute ovals (approximately 0,005 mm in length) from interior of peduncle. Colour yellowish to cream.

Distribution (Fig. 41)

Atlantic Ocean, including the Arctic region, Mediterranean Sea, northern and western Africa, and the south-western Indian Ocean, 9–400 m in depth. Known in southern Africa from Cape Fria and Walvis Bay, Namibia; the Cape of Good Hope region, Cape Province, and the Transkei coast, 78–360 m in depth. Tixier-Durivault (1963: 73) recorded the species from just south of Walvis Bay, Namibia. Tixier-Durivault & D'Hondt (1974: 262) reported the species from Tulear, Madagascar. The type locality is the northern Atlantic.

Remarks

Virgularia mirabilis is distinguished from other southern African species of the genus by the often limp and vermiform appearance of the colonies, with 5–12 autozooids per polyp leaf. Kükenthal (1915: 34) stated that up to 16 autozooids per polyp may be present.

Virgularia gustaviana (Herklots, 1863)

Figs 27, 28A–B, 41

Halisceptrum gustavianum Herklots, 1863: 31.
Virgularia gustaviana Kükenthal & Broch, 1911: 334. Kükenthal, 1915: 74, fig. 77 (Lit.!). Tixier-Durivault, 1954: 630; 1960: 366.

Material

SAM–H1193, Durban Bay (29°50′S 31°00′E), 23 May 1929, 3 colonies. SAM–H1199, off Salisbury Island, Durban Bay, Natal (29°50′S 31°00′E), 4 July 1927, 1 colony. SAM–H1509, Durban Bay (29°50′S 31°00′E), 1 colony.

Description

Colonies examined range between 140–419 mm in length and 10–20 mm in width. Colonies are robust and firm, tapering gradually or abruptly at the apical end. Polyp leaves large, numerous and crowded, placed opposite each other. Autozooids highly congested, more than 50 per leaf (often up to 100 or more). Siphonozooids are inconspicuous on the lateral and dorsal surfaces of the rachis between the polyp leaves. Peduncle length varies from one third to one half of total colony length. Peduncle may have a conspicuous end bulb. Sclerites are minute ovals (*c.* 0,01 mm) restricted to the peduncle interior. Colour yellowish.

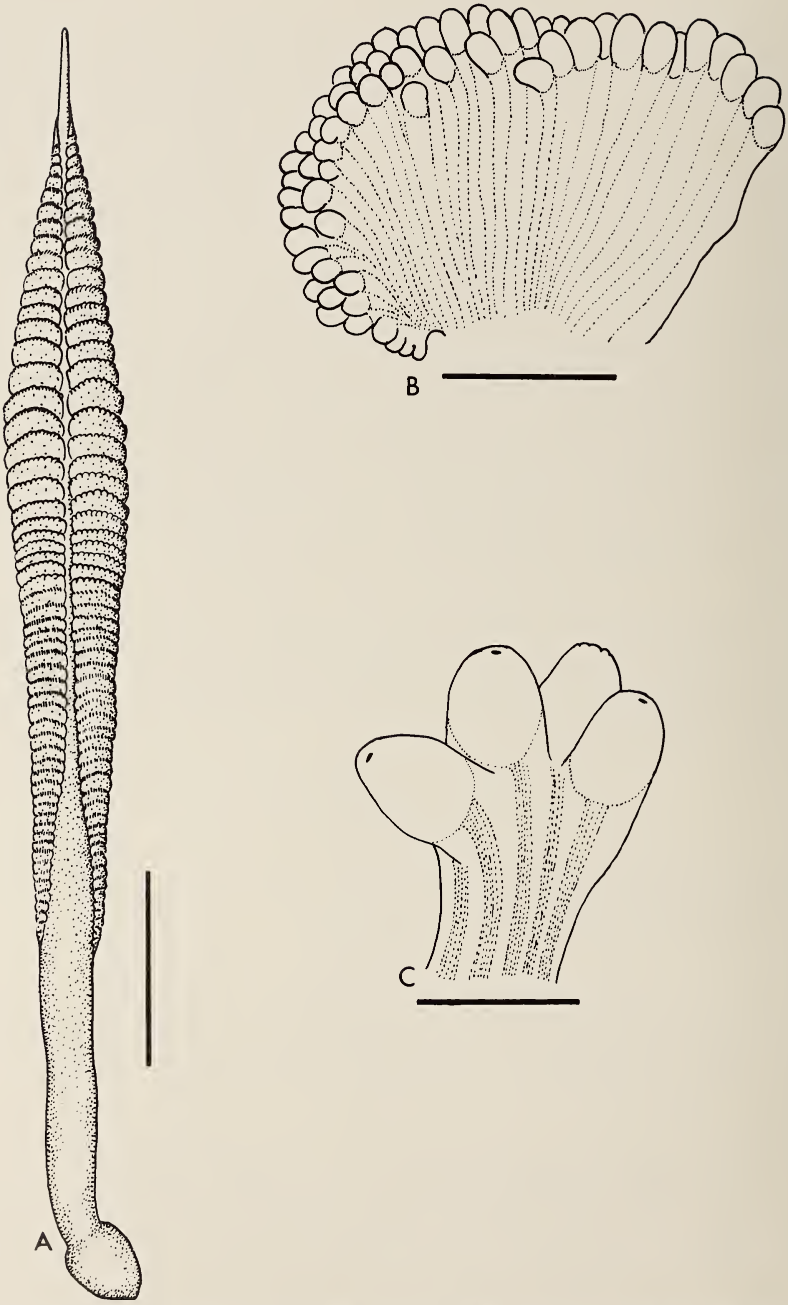

Fig. 27. *Virgularia gustaviana*. A. Entire colony. Scale = 20 mm. B. Single entire polyp leaf. Scale = 3 mm. C. Four adjacent polyps from a polyp leaf. Scale = 1 mm.

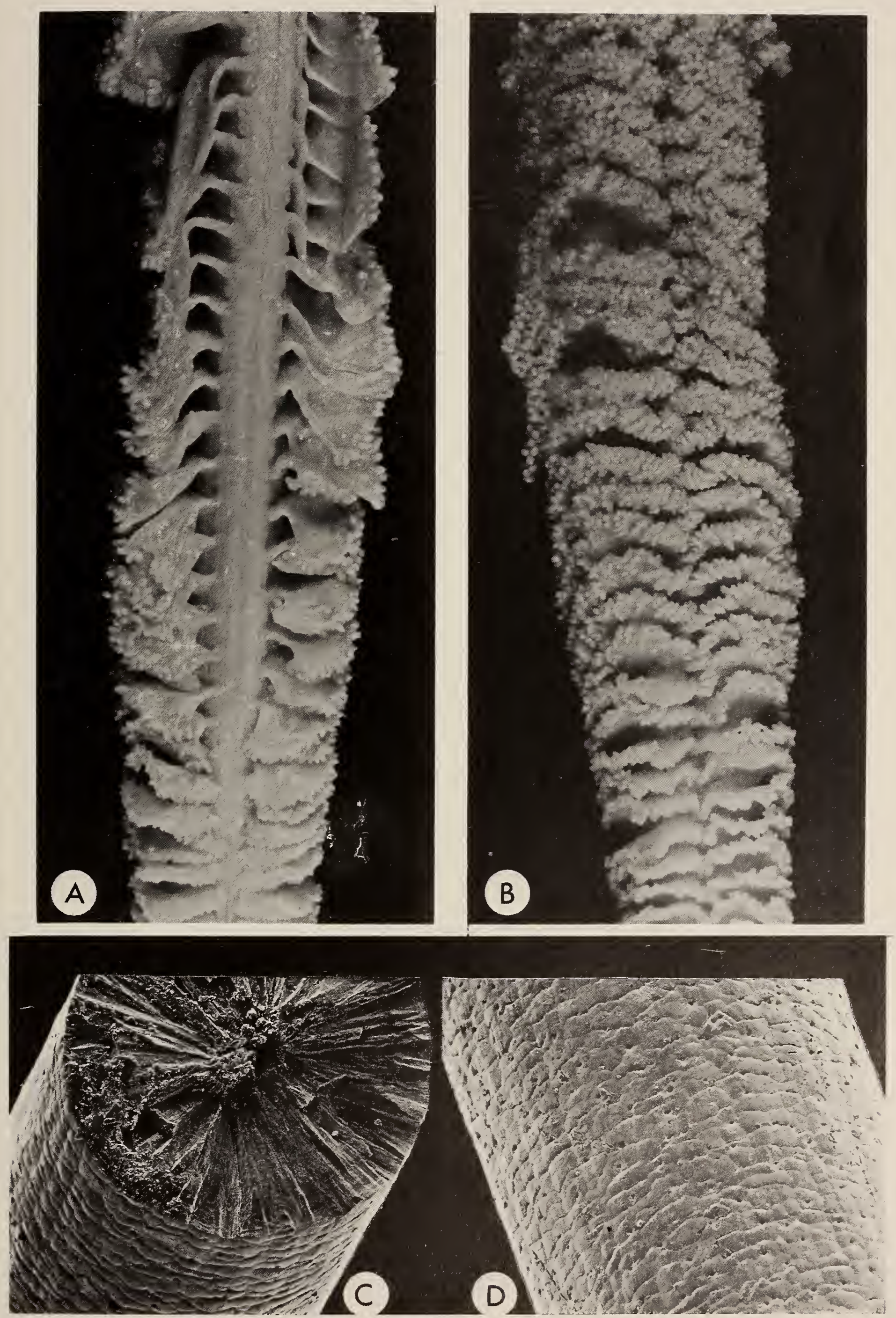

Fig. 28. A–B. *Virgularia gustaviana*. A. Dorsal view of rachis. B. Ventral view of rachis; length of photographs = 80 mm. C–D. *Virgularia schultzei*. C. Broken end of axis; diameter = 0,36 mm. D. Detail of axial surface; width of axis = 0,36 mm.

Distribution (Fig. 41)

Indo-West Pacific. Known in southern Africa only from Inhaca Island, Mozambique, and Durban Bay, Natal; littoral and shallow sublittoral.

Remarks

Virgularia gustaviana is distinguished from other southern African species of *Virgularia* in having 50–200 autozooids per polyp leaf.

Virgularia sp.

Fig. 41

Remarks

Four colonies, 40–80 mm in length, have recently been collected from off the eastern Cape and Transkei (60–410 m in depth). These colonies are fragmentary, therefore assignment to species is untenable at present. The thick and firm appearance of the polyp leaves clearly separates this species from the other southern African forms of *Virgularia*.

Other species of Virgularia

Tixier-Durivault & D'Hondt (1974: 262) listed Port Natal (Durban) as a locality of the Indo-Pacific species *Virgularia juncea* (Pallas, 1766). Since no description or figures of colonies from this locality are given, and since there are no other records or material of *V. juncea* known from southern Africa, I here consider this as a dubious record.

Tixier-Durivault (1963: 73) recorded *Virgularia tuberculata* Marshall, 1887, from northern Angola. This is outside the geographical limit of the present work, but is mentioned here nonetheless as a species that may possibly be encountered further south. It is distinguished by having tubercles or small teeth on the terminal rim of the calyx and only 3–6 autozooids per polyp leaf.

Genus *Scytaliopsis* Gravier, 1906

Scytaliopsis Gravier, 1906: 293; 1908: 237. Kükenthal, 1915: 67.

Diagnosis

Colony firm. Axis circular in cross-section. Gradual transition between rachis and peduncle. Small polyp leaves in pairs, separated by areas of bare rachis. Autozooids 4–5 per polyp leaf. Innermost autozooids of each polyp leaf smaller than adjacent ones. Anthocodiae are retractile into the globular, fleshy bases of autozooids. Siphonozooids few and inconspicuous, situated on rachis between leaves. Sclerites absent.

A monospecific genus of the western Indian Ocean and Red Sea.

Type species. Scytaliopsis djiboutiensis Gravier, 1906; Djibouti (Red Sea).

Scytaliopsis djiboutiensis Gravier, 1906.

Figs 29, 41

Scytaliopsis djiboutiensis Gravier, 1906: 293; 1908: 237. Kükenthal, 1915: 67 (figs 66, 67).

Material

SAM–H3711, off Qora River, Transkei (32°35,4'S 28°49,2'E), 450–460 m, 14 July 1984, 1 colony, dredge, G. C. Williams, R.V. *Meiring Naude*.

Description

The colony is 92 mm in length; rigid, straight, and shaft-like. Peduncle shorter than rachis. Polyp leaves arranged in 15–20 pairs, each leaf with not more than five autozooids. Adjacent autozooids gradually increase in size from innermost to outermost. Intervals of bare rachis up to 3 mm. Siphonozooids are very sparse and inconspicuous, usually not more than two are present on the rachis below each pair of polyp leaves. Sclerites entirely absent. Colour brownish.

Distribution (Fig. 41)

East African coast, littoral to 460 m in depth. This is the first record of the genus and species for southern Africa and extends the range southward from the Red Sea to the Transkei coast. The type locality is Djibouti, Red Sea.

Remarks

This species is differentiated from other southern African pennatulaceans by having 5 polyps per polyp leaf, which grade in size from the smallest on the dorsal side of each leaf to the largest on the ventral side.

Subfamily Balticininae Gray, 1870

Fusion of proximal portions of adjacent autozooids forms raised ridges or swellings that emanate laterally from the rachis. Siphonozooids few and inconspicuous between autozooids.

One genus of the Atlantic and Indo-Pacific oceans.

Genus *Halipteris* Kölliker, 1869

non *Virgularia* Lamarck, 1816: Koren & Danielssen, 1847: 269.
Halipteris Kölliker, 1869: 124.
Pavonaria Kölliker, 1869: 123 (*non* Schweigger, 1820; see Bayer, 1956: F228). Kükenthal & Broch, 1911: 305. Kükenthal, 1915: 60 (Lit!).
Balticina Gray, 1870: 13.
Norticina Gray, 1870: 13.
Osteocella Gray, 1870: 40.
Lygomorpha Koren & Danielssen, 1877: 99.
Stichoptilum Grieg, 1887: 15.

Diagnosis

Colonies long and slender. Axis conspicuous, extending entire length of colony, round in cross-section. Autozooids arranged in numerous oblique rows in

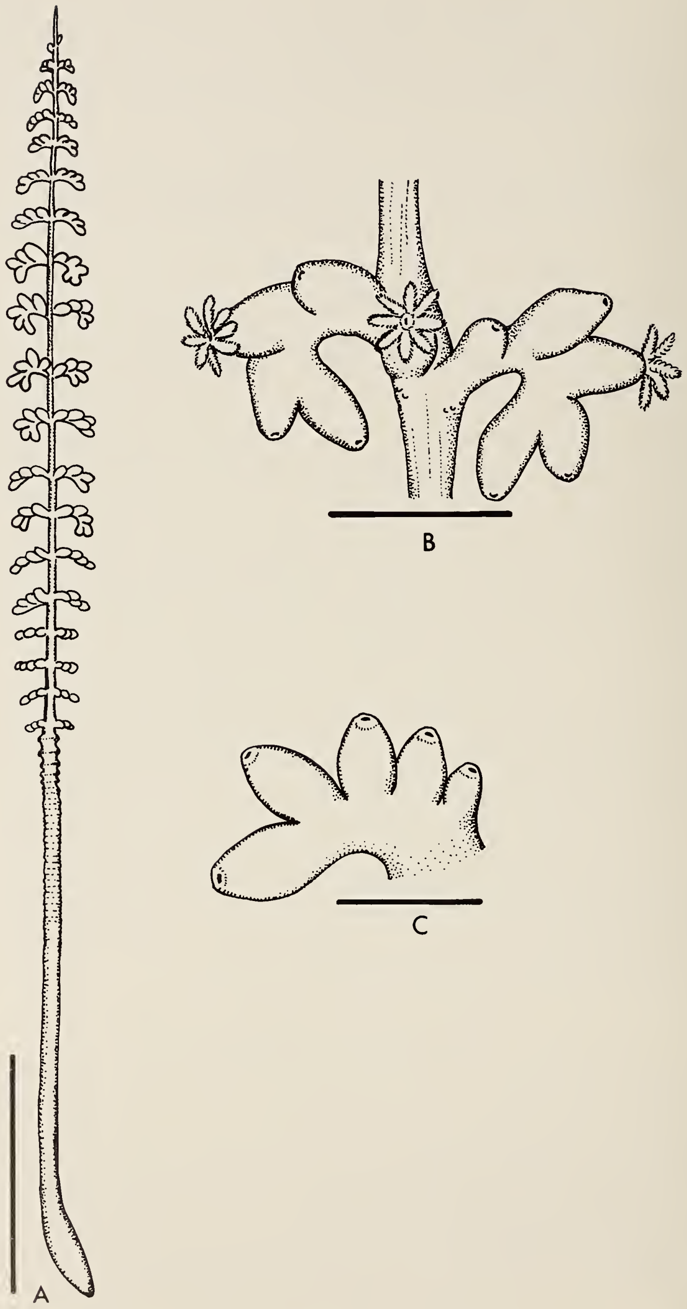

Fig. 29. *Scytaliopsis djiboutiensis*. A. Entire colony. Scale = 20 mm. B. Detail of rachis showing two polyp leaves. Scale = 2 mm. C. Single polyp leaf showing gradation in size of adjacent autozooids. Scale = 2 mm.

two longitudinal series. Adjacent autozooids sometimes fused at their bases, often forming ridges or swellings that emanate laterally from the rachis. Autozooids with two-toothed calyces. Anthocodia retractile into calyces. Sclerites numerous; three-flanged spindles in calyx and tentacles, smooth rods or spindles in peduncle.

A genus of five species; Atlantic, Pacific and Western Indian oceans.

Type species. *Virgularia finmarchica* Sars, 1851; northern Atlantic.

Halipteris africana (Studer, 1879) comb. nov.

Figs 19A–G, 30, 40

Halipteris sp. Studer, 1878: 139.
Pavonaria africana Studer, 1879: 672, pl. 5 (fig. 41). Kükenthal, 1915: 61.

Material

SAM–H3237, north-west of Lamberts Bay, western Cape Province (31°29,7′S 16°03,4′E), 459 m, 15 August 1947, 1 colony, dredge, University of Cape Town Ecological Survey, AFR730G. SAM–H4027, off Namaqualand (30°00,5′S 14°53,6′E) 461 m, 20 July 1986, 8 colonies, bottom trawl, Rob Leslie (Sea Fisheries Research Institute, West Coast Biomass Survey, station A4373046).

Description

Colonies whip-like, up to 1 550 mm in length and averaging 10 mm in width. Axis round to rounded quadrangular, approximately 5 mm in diameter. Peduncle stout, approximately 200 mm long and up to 15 mm wide. Peduncle distinctly quadrangular. Autozooids arranged in numerous oblique rows, 3–7 (usually 4–6) per row. Some rows form basal ridges by fusion of proximal regions of autozooids. In some rows, circular or elliptical walls of the basal ridge surround individual autozooids or groups of two or three. Aboral surface of tentacles with densely set three-flanged spindles, 0,10–0,15 mm in length, arranged longitudinally. Calyx with numerous three-flanged spindles 0,12–0,60 mm long. Terminal teeth of calyx sometimes blunt or indistinct. Peduncle with smooth spindles or rods 0,04–0,07 mm in length. Rachis and peduncle pale red to white, calyx light blue, polyps brown.

Distribution (Fig. 40)

Atlantic coast of Africa, 459–659 m in depth. This study represents a new record from southern Africa and extends the range of the species south from the Senegal–Guinea region to the Namaqualand coast, South Africa. The type locality is tropical west Africa.

Remarks

Gray (1870: 13) described two genera: *Balticina* for *B. finmarchica* (Sars, 1851) and *Norticina* for *N. christii* (Koren & Danielssen, 1848), presumably after

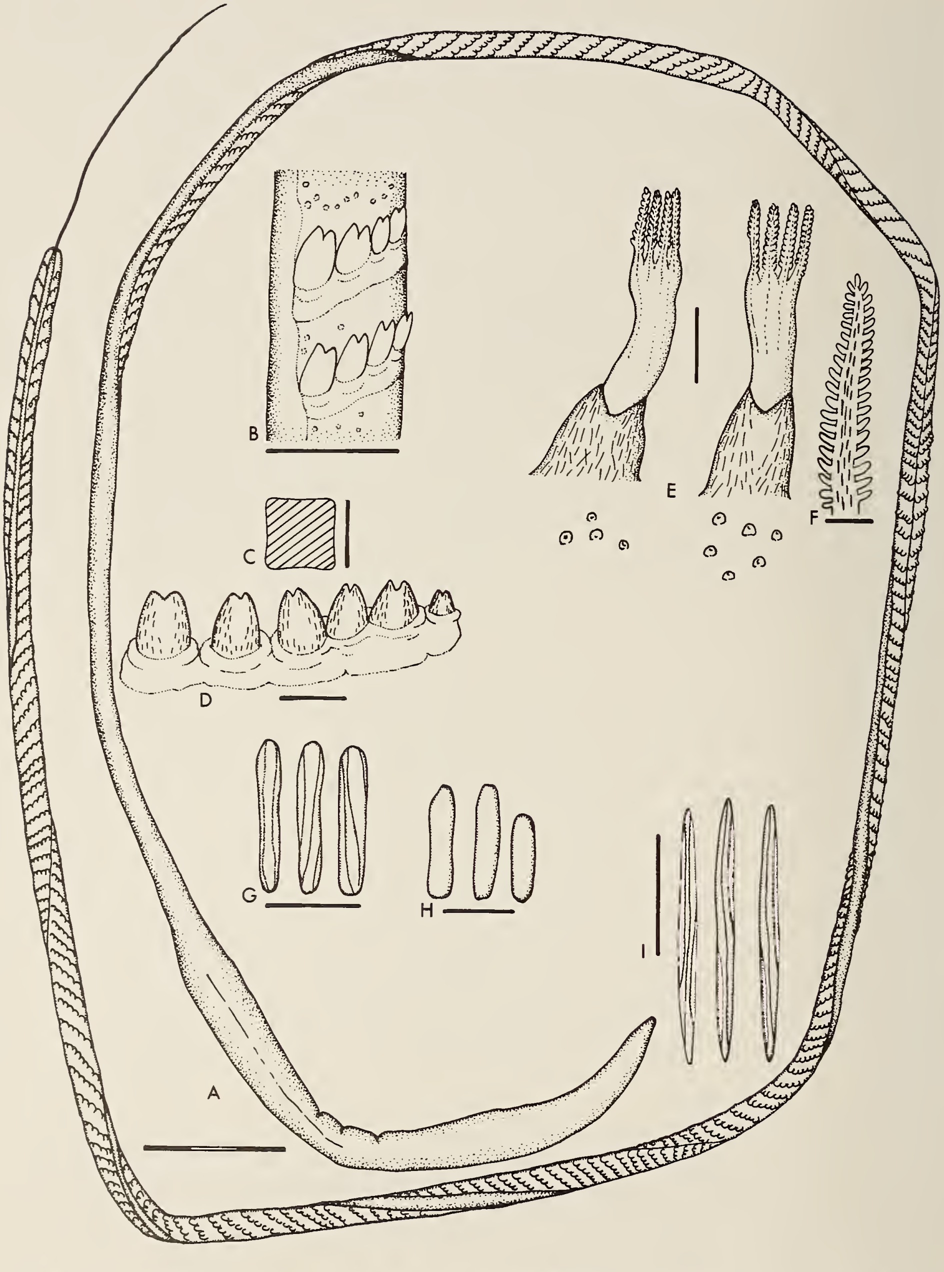

Fig. 30. *Halipteris africana*. A. Entire colony. Scale = 30 mm. B. Detail of rachis. Scale = 7 mm. C. Transverse section of axis. Scale = 7,5 mm. D. Group of six autozooids with common basal ridge. Scale = 2 mm. E. Two autozooids with ten siphonozooids at their bases. Scale = 2 mm. F. Single tentacle with sclerites. Scale = 0,5 mm. G. Sclerites from tentacle. Scale = 0,1 mm. H. Sclerites from peduncle. Scale = 0,04 mm. I. Sclerites from calyx. Scale = 0,25 mm.

the Baltic and Nordic (North) seas, respectively. Both genera are considered synonyms of *Pavonaria* Kölliker, 1869, by Kükenthal (1915: 60). However, *Pavonaria* was found by Kükenthal (1915: 60) and Bayer (1956: 228) to be preoccupied by *Pavonaria* Schweigger, 1820, a synonym of *Funiculina*. Therefore the name *Halipteris* Kölliker, 1869, which is synonymous with *Pavonaria* Kölliker, 1869, is the valid generic name (M. Grasshoff pers. comm.).

Tixier-Durivault made the original determination for this specimen and identified it as *Funiculina armata* Verrill, 1879. However, the possession of ridges in oblique rows, which unify the fused bases of adjacent autozooids, and the autozooids with calyces of two terminal teeth prove this to be a misidentification. Tixier-Durivault (1954: 629) also listed *F. armata* from South Africa based on two specimens collected on the same day and in the same vicinity as the present specimen. I consider this a dubious record until these specimens can be examined.

Kükenthal (1915: 60–61) distinguished *B. africana* by the possession of five or six autozooids per row, and the presence of contiguous distal portions of the basal swellings of the polyp leaves that may surround the proximal regions of several adjacent autozooids. This latter feature is common in autozooids of the colony examined but is not universal (Fig. 31D).

Jungersen (1904: 43) maintained that *B. africana* is probably not a distinct species but rather a southern form of the common Atlantic species, *B. finmarchica* (Sars, 1851). However, he did not make a formal synonymy. The distinguishing characters recognized by Studer (4–6 autozooids per row and low ridges with wall-like extensions around individual autozooids) may indeed not be sufficient for specific differentiation. A comparison of many specimens from various localities is necessary.

Remarks on the genus Halipteris

Three additional colonies assignable to the genus *Halipteris* are present in the South African Museum's collection. They are from the Natal south coast (900–625 m), the Transkei coast (300 m), and the Namaqualand coast (457 m). The three colonies are relatively small (105–220 mm in length) and apparently represent at least two species, which have not been identified at present.

Family **Pennatulidae** Ehrenberg, 1834

Colonies bilateral with large polyp leaves. Autozooids in one or more rows on margin of polyp leaves. Anthocodia retractile into calyces with marginal teeth. Siphonozooids confined to rachis. Mesozooids may be present. Sclerites numerous; mostly three-flanged needles, rods, plates, or ovals.

Three genera: *Pennatula* Linnaeus, 1758, of cosmopolitan distribution; and *Leioptilus* Gray, 1860, and *Ptilosarcus* Gray, 1860, both restricted to the Pacific coast of North America.

Genus *Pennatula* Linnaeus, 1758

Pennatula Linnaeus, 1758: 818. Kükenthal & Broch, 1911: 348. Kükenthal, 1915: 81 (Lit.!). Grasshoff, 1982*b*: 959.
Penna Bohadsch, 1761: 98 (*partim*).

Diagnosis

Calyces usually with eight terminal teeth. Calyces tubular with numerous sclerites, which are three-flanged needles. Inconspicuously three-flanged spindles and plates occur in peduncle.

A cosmopolitan genus of probably 12 to 15 valid species and many uncertain or dubious ones.

Type species. Pennatula phosphorea Linnaeus, 1758.

Pennatula inflata Kükenthal, 1910

Figs 31A–B, 32, 33A–C, 34, 35, 40

Pennatula inflata Kükenthal, 1910: 52; 1915: 83, figs 81–83. Kükenthal & Broch, 1911: 350, pl. 17 (fig. 25), pl. 22 (figs 61, 62).
Pennatula phosphorea (*non* Linnaeus, 1758) Tixier-Durivault, 1954: 630.

Material

SAM–H3238, north-west of Lambert's Bay (31°43,6′S 16°13,2′E), 457 m, 9 June 1947, 2 colonies, trawl, University of Cape Town Ecological Survey.

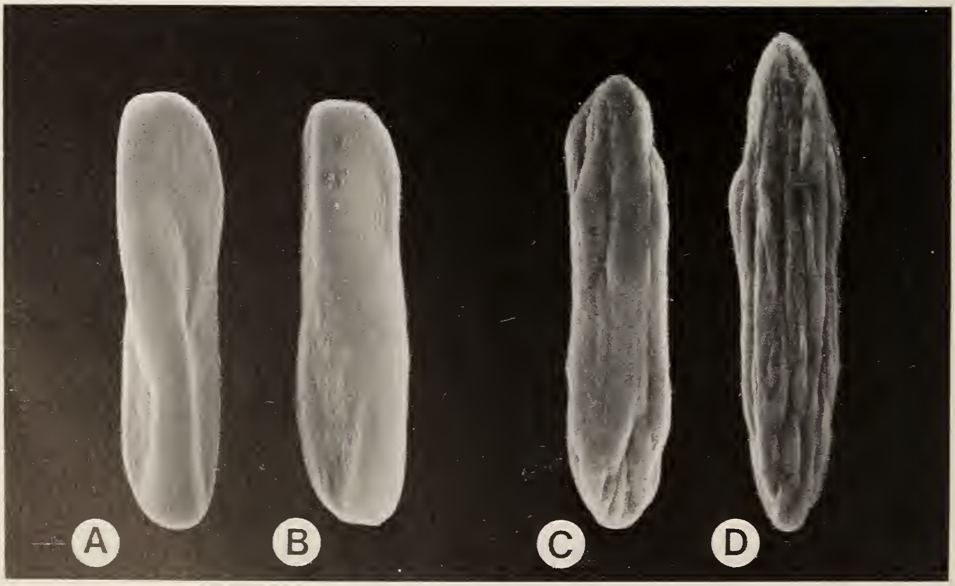

Fig. 31. Scanning electron micrographs of sclerites. A–B. *Pennatula inflata*. From surface of peduncle: 0,1 mm; 0,08 mm. C–D. *Pteroeides isosceles*. From surface of peduncle: 0,08 mm; 0,1 mm.

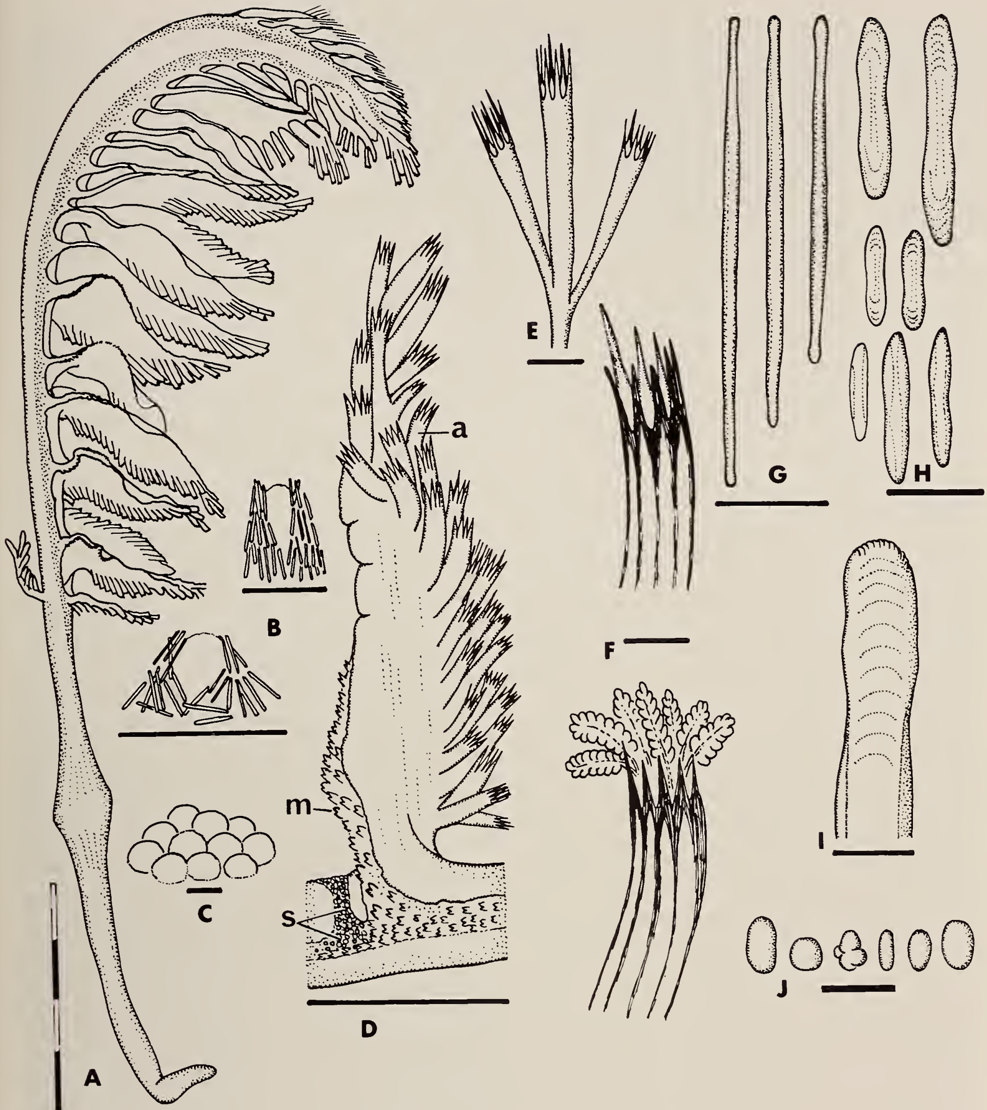

Fig. 32. *Pennatula inflata*. A. Entire colony, lateral view. Scale 40 mm. B. Two mesozooids with sclerites. Scale = 0,3 mm. C. Group of siphonozooids. Scale = 0,2 mm. D. Single polyp leaf showing positions of autozooids (a), mesozooids (m), and siphonozooids (s). Scale = 8,8 mm. E. Group of three retracted autozooids. Scale = 1,6 mm. F. Two autozooids showing sclerite arrangement. Scale = 1 mm. G. Three sclerites from calyx. Scale = 0,3 mm. H. Seven sclerites from surface of peduncle. Scale = 0,1 mm. I. Terminal tip of a calyx sclerite. Scale = 0,035 mm. J. Sclerites from interior of peduncle. Scale = 0,03 mm.

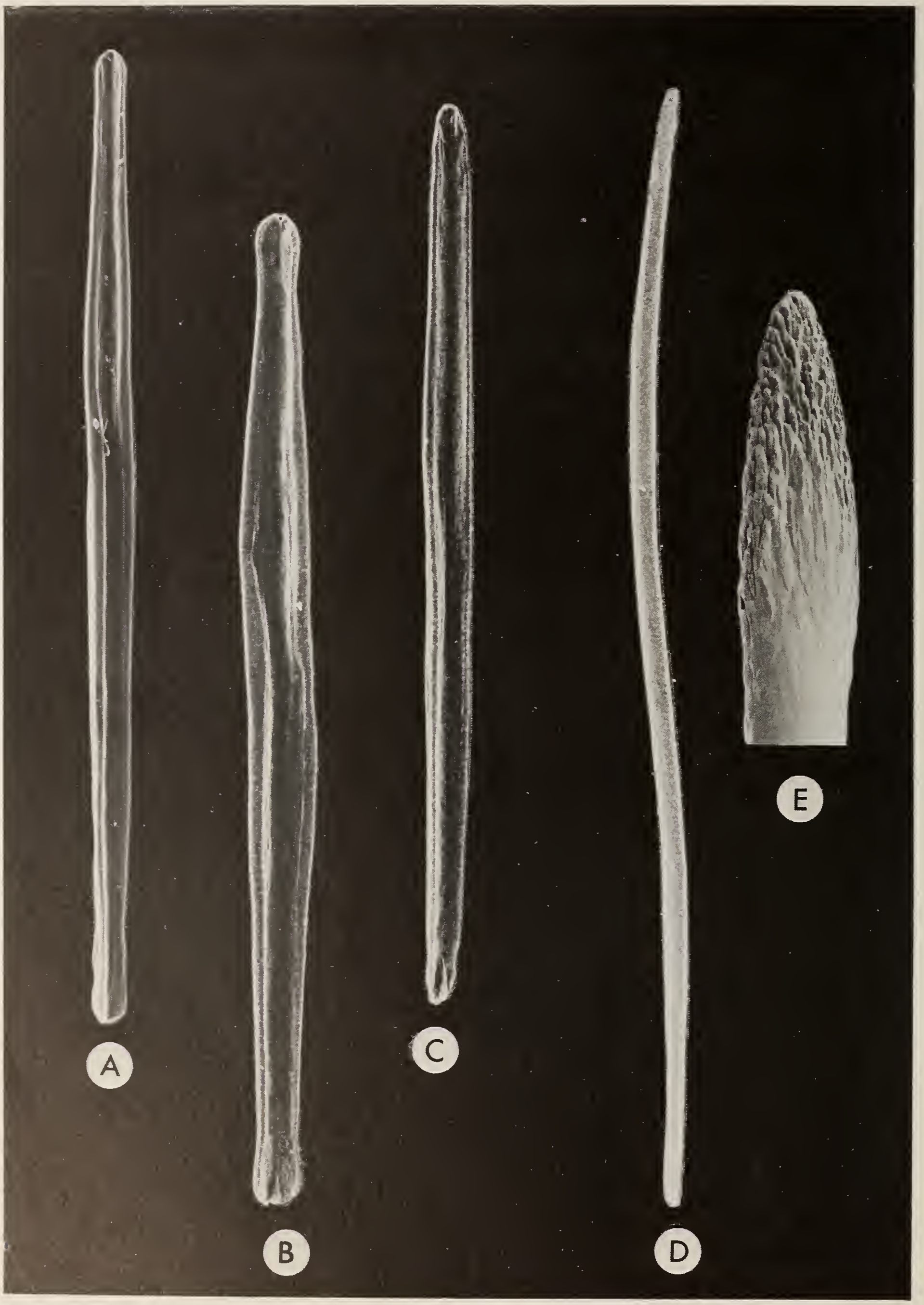

Fig. 33. Scanning electron micrographs of sclerites. A–C. *Pennatula inflata*. From calyx: 0,8 mm; 0,6 mm; 0,8 mm. D–E. *Pteroeides isosceles*. D. Needle from supporting ray of polyp leaf: 7 mm. E. Terminal tip of needle from supporting ray: 1,3 mm.

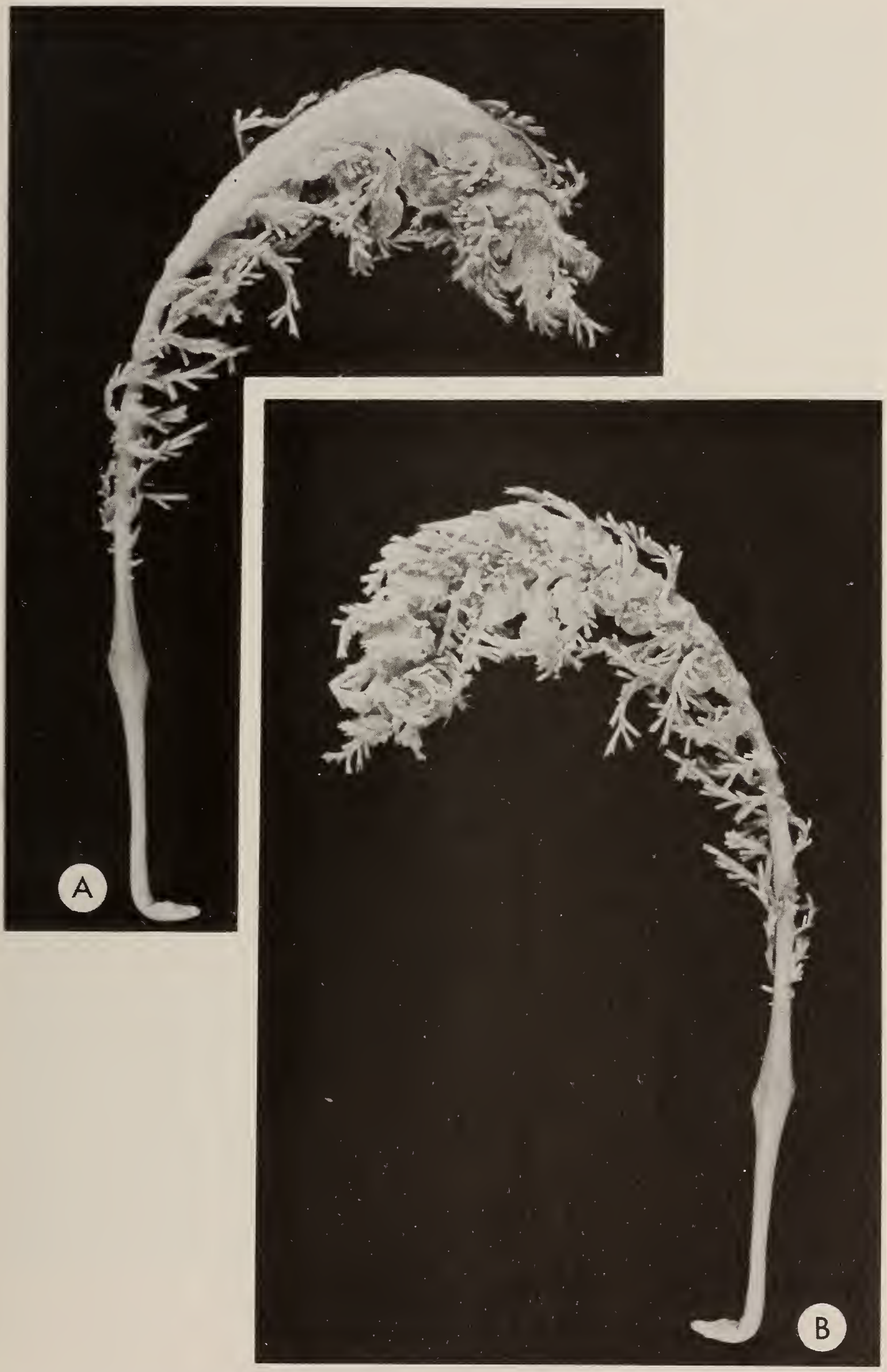

Fig. 34. *Pennatula inflata*. Entire colony; length 220 mm. A. Dorsal view. B. Ventral view.

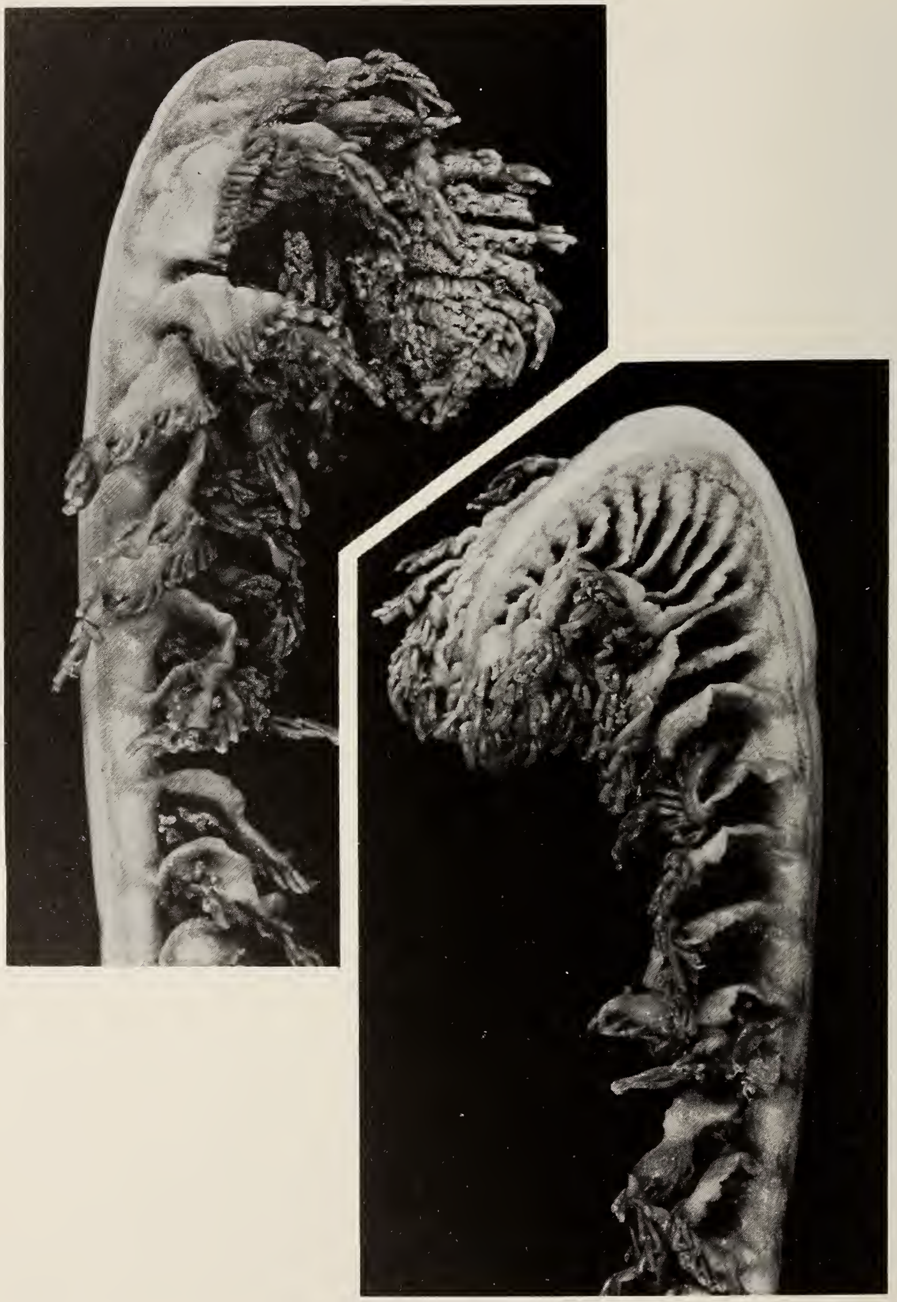

Fig. 35. *Pennatula inflata*. Two views of distal portion of rachis. Length of rachis portion shown is 150 mm.

Description

The colonies examined are 220 mm and 400 mm in length. Peduncle stout, rigid, one-third total length of colony, oval in cross-section. Prominent bulb about midway on peduncle. Rachis spongy and flexible, with naked dorsal tract up to 10 mm in width. This tract is widest in the distal half of the rachis. Polyp leaves well developed, up to 40 mm in length and 16 mm in width, 26–37 pairs of polyp leaves per colony. Autozooids 29–42 per polyp leaf, in usually 2 or 3 ill-defined rows. Calyces tubular, up to 10 mm long, eight-toothed, with teeth equal to subequal; many calyces with one tooth more strongly developed than the others. Zooids dimorphic, dense and numerous on two narrow marginal tracts bordering dorsal face of rachis. Mesozooids with two tooth-like points composed of sclerites, common in a row along the basal dorsal margin of each polyp leaf. Siphonozooids without sclerites, crowded in narrow band on rachis above each polyp leaf. Colonies with 26–37 rows of siphonozooids on each side, representing one row per polyp leaf. Sclerites numerous; three-flanged needles in calyx, up to 1,2 mm in length; inconspicuously three-flanged spindles of peduncular surface up to 0,2 mm in length; minute oval plates in peduncular interior 0,015–0,025 mm long. Colour of peduncle, rachis and leaves yellowish-white to reddish-orange, sclerites of autozooids and mesozooids orange, siphonozooids white.

Distribution (Fig. 40)

East African coast and south-west coast of South Africa, 457–741 m in depth. The present study establishes a new record for southern Africa and extends the range south-west from Somalia to the Namaqualand coast, South Africa. It is the first record of the species for the Atlantic Ocean. The type locality is Somalia (Indian Ocean), 628–741 m in depth.

Remarks

Tixier-Durivault (1954: 630) identified these specimens as *P. phosphorea*. However, the possession of mesozooids on the dorsal edge of the polyp leaves proves this to be a misidentification. According to Kükenthal (1915: 82), *P. phosphorea* does not possess mesozooids and does not possess more than 20 polyps per mature polyp leaf.

Day (1974*b*: 35) recorded several unidentified species of the genus *Pennatula* from Delagoa Bay, Mozambique.

Of the twelve species of *Pennatula* considered to be valid by Kükenthal (1915: 81), six possess between 3 and 20 polyps per polyp leaf—*P. aculeata* Danielssen, 1860; *P. indica* J. A. Thomson & Henderson, 1906; *P. murrayi* Kölliker, 1880; *P. pearceyi* Kölliker, 1880; *P. phosphorea* Linnaeus, 1758; and *P. prolifera* Jungersen, 1904. Six additional species have 30–100 polyps per polyp leaf—*P. fimbriata* Herklots, 1858; *P. grandis* Ehrenberg, 1834; *P. inflata* Kükenthal, 1910; *P. moselyi* Kölliker, 1880; *P. naresi* Kölliker, 1880; and *P. rubra* (Ellis *in* Bohadsch, 1761). Of these, only *P. inflata* possesses a wide naked dorsal tract of the upper rachis with a spongy texture, and many calyces have one tooth more strongly pronounced than the others.

A certain amount of variation occurs with regard to the calyx teeth in *P. inflata*. In the present specimens, the development of the calyx teeth is variable—many autozooids examined possess eight equal or subequal teeth. However, in a few polyps, one, two, three, or four of the teeth may be somewhat larger in size than the remaining teeth; and in many polyps one tooth is slightly or distinctly larger than the other seven teeth.

Family **Pteroeididae** Kölliker, 1880

Colonies bilateral, possessing well-developed and rigid polyp leaves with long stout sclerites that are not three-flanged. Siphonozooids crowded in proximal region of leaves. Autozooids retractile into fleshy distal region of polyp leaves, or into rounded calyces that are not composed of dense sclerites.

Three genera of the Atlantic and Indo-Pacific: *Pteroeides* Herklots, 1858; *Sarcoptilus* Gray, 1848; and *Crassophyllum* Tixier-Durivault, 1961*a*.

Genus *Pteroeides* Herklots, 1858

Pteroeides Herklots, 1858: 19. Kölliker, 1872*a*: 124. Gray, 1870: 24. Kükenthal & Broch, 1911: 395. Kükenthal, 1915: 97.
Godeffroyia Kölliker, 1869: 222.
Argentella Gray, 1870: 22.
Pteromorpha Gray, 1870: 23.
Crispella Gray, 1870: 25.

Diagnosis

Polyp leaves with supporting rays composed of long needle-like sclerites. Needles of supporting rays smooth, except for terminal ends that are somewhat tuberculated. Sclerites of peduncle are rods or spindles.

A genus of over 80 named species, including many uncertain or dubious ones; Atlantic, Mediterranean, and Indo-Pacific.

Type species. Penna grisea Bohadsch, 1761 (= *Pennatula spinosa* Ellis, 1764); Europe.

Pteroeides isosceles Thomson, 1915

Figs 31C–D, 33D–E, 36, 37, 38

Pteroeides isosceles J. S. Thomson, 1915: 17, pl. 1.

Material

SAM–H1207, off East London (33°00'S 28°00'E), 58–69 m, 28 November 1906, 1 colony, large trawl, S.S. *Pieter Faure* Survey, P.F. 19061 (holotype).

Redescription of the holotype

The colony is 170 mm long and up to 40 mm in width. Peduncle 18–20 mm in diameter and slightly more than half the length of the colony. Rachis with 22 pairs of polyp leaves. Larger leaves 20 mm in width by 35 mm in length, 15–18 rays per leaf in leaves from the middle region of the rachis. Rays extend through the entire length of a particular leaf and may extend 1–2 mm beyond the margin. Rays not visible in the basal plate of siphonozooids. Autozooids restricted to the outer margin of each leaf to 5 mm below the margin on both the upper and lower surfaces of each leaf; retractile directly into pockets of the fleshy leaf margin. Autozooid zone relatively free of smaller spindles. The autozooids are not arranged in distinct rows, but 5–8 autozooids are usually scattered between two adjacent rays. Mesozooids not apparent. Siphonozooids are densely arranged and restricted to a plate about 12 mm broad in the proximal region of each leaf. Needles of rays up to 10 mm long. Spindles of dorsal surface of polyp leaves 0,2–0,4 mm in length. Rods and spindles of peduncular surface are longitudinally grooved but not distinctly three-flanged, 0,10–0,17 mm long. Sclerites of peduncular interior absent. Peduncle gray, leaves cream with yellowish siphonozooids and white rays.

Distribution (Fig. 38)

Known only from the type locality off East London, South Africa, 58–69 m depth.

Remarks

This species can be differentiated from other southern African sea pens by having autozooids without calyces united into thick, fleshy polyp leaves, 11–18 conspicuous rays per leaf, and siphonozooids densely set but restricted to a plate near the base of each leaf.

Remarks on the genus Pteroeides

Recent collections from northern Zululand have yielded several colonies of a species distinct from *P. isosceles*, which has not been identified. Several damaged or presumably young colonies of *Pteroeides* from Natal are also present in the South African Museum collection that can not presently be identified to species but seem to be distinct from *P. isosceles*. It is likely that several species of the genus can be expected to occur in southern African waters. The genus is in much need of revision; well over 80 specific names can be found in the literature at present.

Broch (1958: 278) recorded *Pteroeides griseum* (Bohadsch, 1761) from off the Angola/Namibia border region at 80–91 m. This is just north of the geographic range of the present work, but is mentioned since the species may be encountered further south. It is distinguished from *P. isosceles* by having numerous spindles in the autozooid zone, independent of the ray needles. In *P. isosceles* the ray

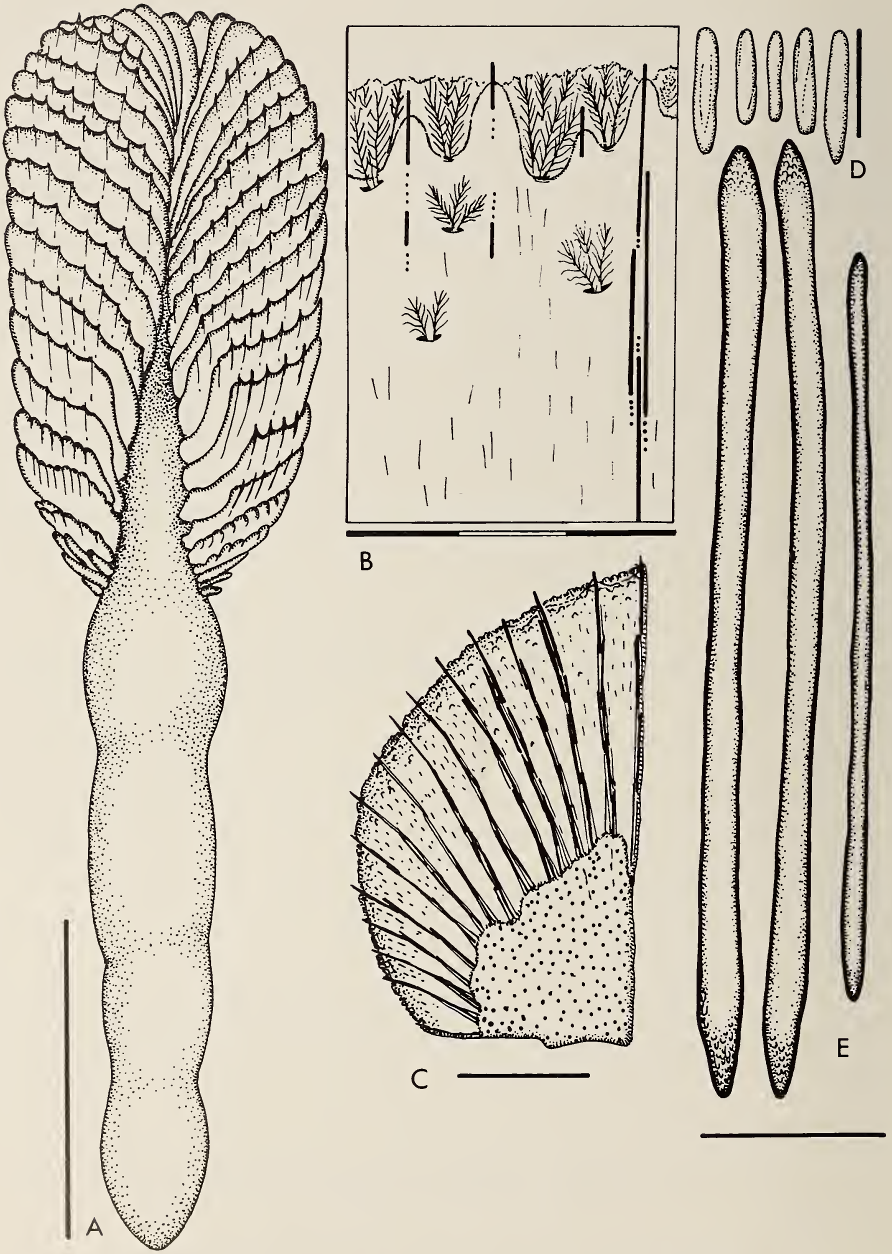

Fig. 36. *Pteroides isosceles*. A. Entire colony, ventral face. Scale = 60 mm. B. Detail of margin of polyp leaf, upper surface. Scale = 3 mm. C. Entire polyp leaf, lower surface. Scale = 10 mm. D. Peduncular surface sclerites. Scale = 0,1 mm. E. Ray needles from polyp leaf. Scale = 2 mm.

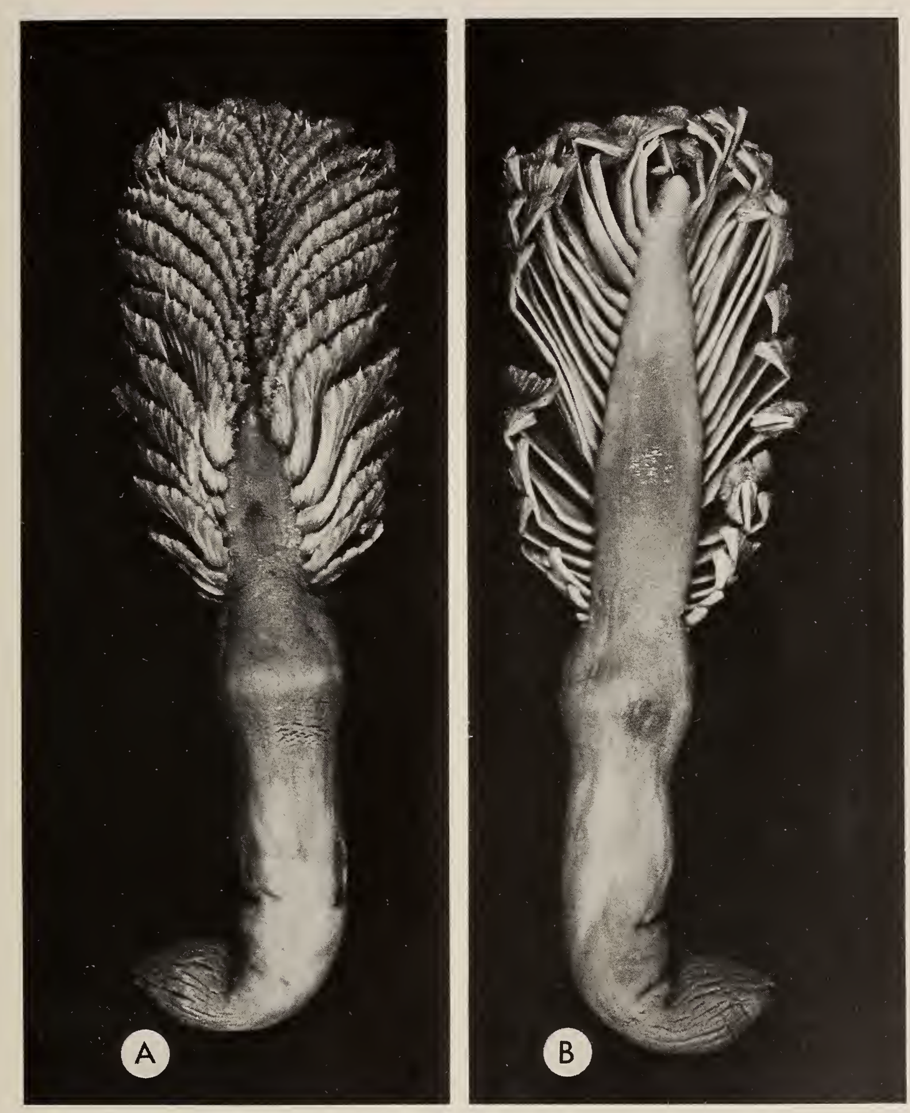

Fig. 37. *Pteroeides isosceles*. Entire colony, length 170 mm. A. Ventral view. B. Dorsal face.

needles are pointed and similar at both ends; the autozooid margins may have only scattered sclerites that differ from the ray needles; the siphonozooid and autozooid zones have a distinct boundary.

J. S. Thomson (1915: 17) described a damaged colony from the type locality of *Pteroeides isosceles* as *Pteroeides* sp. An examination of this specimen has shown that it closely resembles the holotype of *P. isosceles* and thus the two specimens are very likely conspecific.

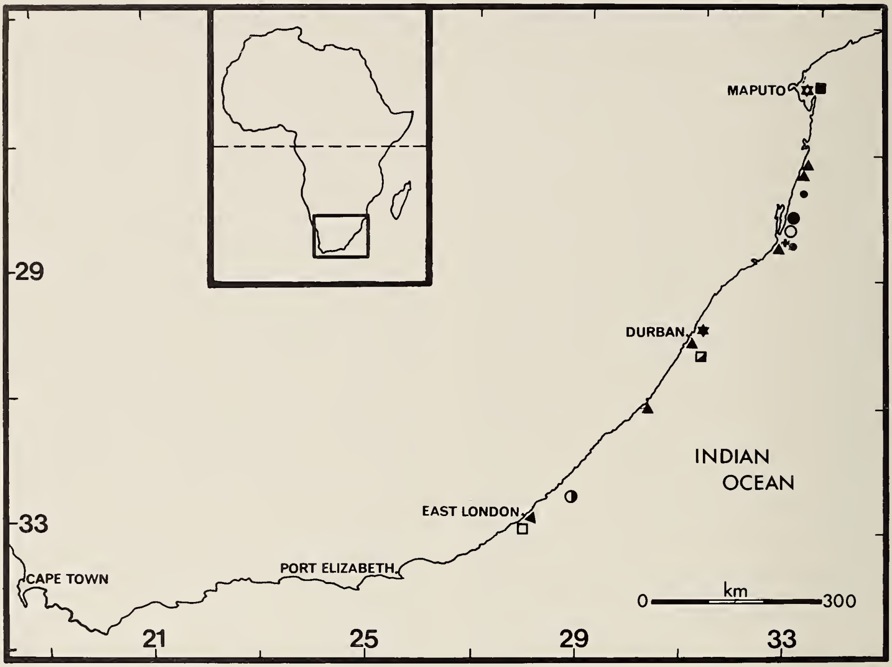

Fig. 38. Map of south-eastern Africa showing known collecting stations for twelve pennatulacean species: *Amphiacme abyssorum* (•); *Calibelemnon* sp. (●); *Cavernularia dayi* (▲); *Cavernularia lutkenii* (☆); *Cavernulina* sp. (★); *Chunella gracillima* (+); *Funiculina quadrangularis* (○); *Kophobelemnon* sp. (◩); *Pteroeides isosceles* (□); *Scleroptilum* sp. (◑); *Veretillum leloupi* and *V. cynomorium* (■).

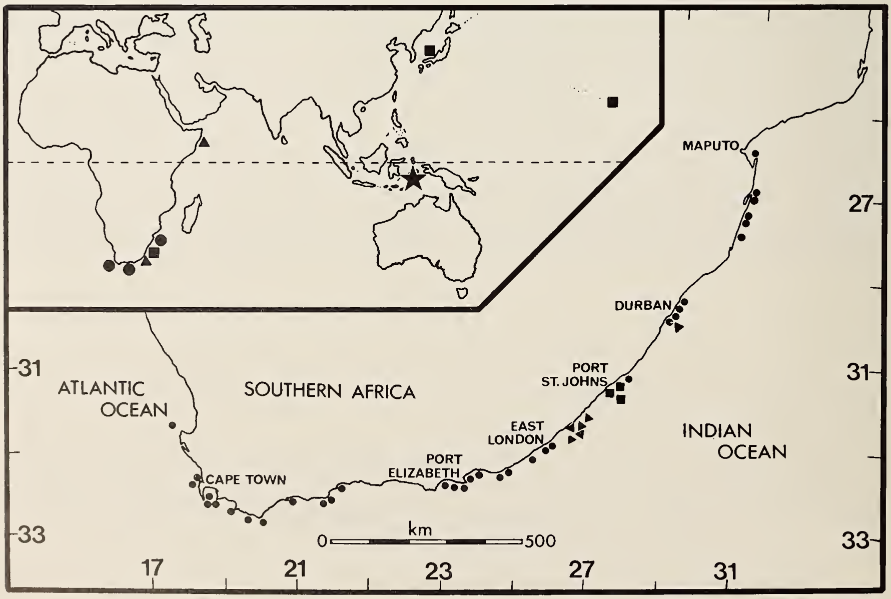

Fig. 39. Map showing known distribution of the family Echinoptilidae: *Actinoptilum molle* (●); *Echinoptilum echinatum* (▲); *Echinoptilum macintoshii* (■); *Echinoptilum asperum*, *E. elongatum*, *E. minimum*, *E. roseum* (★).

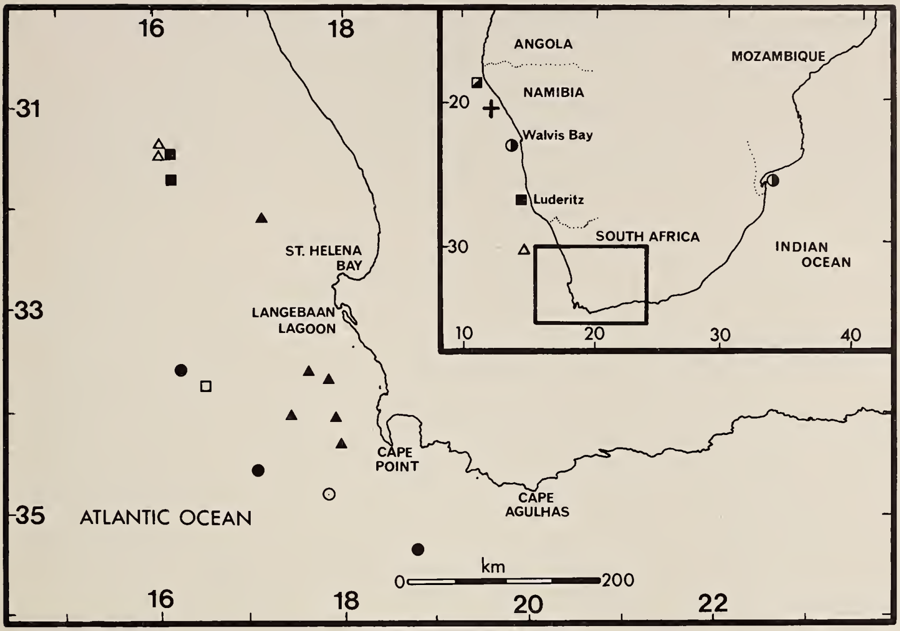

Fig. 40. Map of south-western Africa showing known collecting stations of eight pennatulacean species: *Anthoptilum grandiflorum* (▲); *Cavernularia elegans* (◪); *Distichoptilum gracile* (☐); *Halipteris africana* (△); *Kophobelemnon stelliferum* (+); *Pennatula inflata* (■); *Umbellula lindahli* (●); *Umbellula thomsoni* (○); *Veretillum cynomorium* (◑).

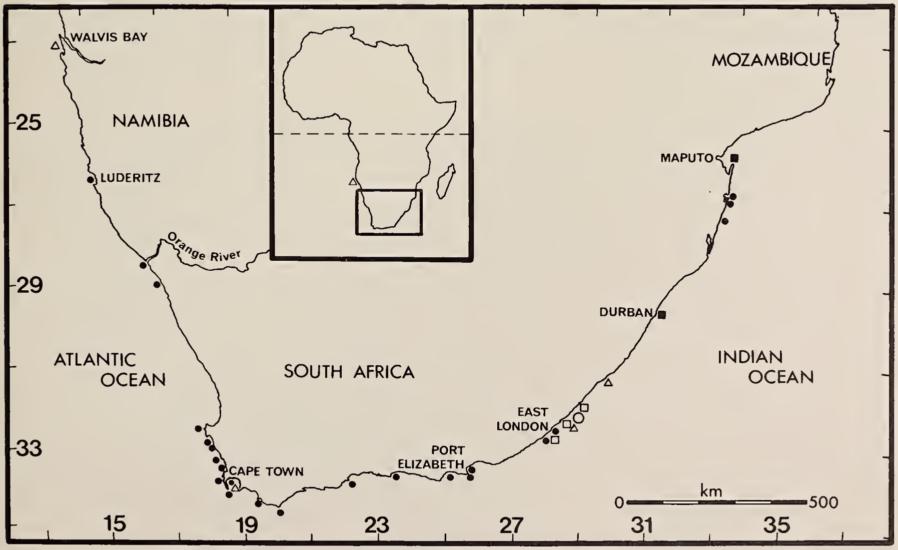

Fig. 41. Map showing known collecting stations for the family Virgulariidae (subfamily Virgulariinae) in southern Africa: *Scytaliopsis djiboutiensis* (○); *Virgularia gustaviana* (■) *Virgularia mirabilis* (△); *Virgularia schultzei* (●); *Virgularia* sp. (☐).

Remarks on the genus Crassophyllum

Tixier-Durivault (1961*a*: 428) described a new genus and species, *Crassophyllum cristatum*, from northern Angola. It is mentioned here since it may possibly be encountered further south. This form is distinguished by the lack of supporting rays in the polyp leaves, but possesses scattered spindles and needles in the region between the siphonozooid plate and the polyp leaf margin.

DISCUSSION

ZOOGEOGRAPHY

The littoral and sublittoral benthic regions of southern Africa constitute a remarkably diverse and biogeographically unique area. The region is made up of cold-water and warm-water temperate elements, as well as a tropical component. In particular, the southernmost coast (the region between the Cape Peninsula and Port St. Johns) has a high degree of endemism in the invertebrate fauna (Ekman 1953: 189; Day *et al.* 1970: 2). This region is referred to as the 'Agulhas Province' by Briggs (1974: 149), the 'Cape Fauna' by Stephenson & Stephenson (1972: 101), and the 'South Coast' fauna by Ekman (1953: 187) and Millard (1978).

The peculiarities of this region and the composition of the fauna are due to a number of factors. Most important of these are: (1) the isolated, peninsular nature of southern Africa, which is bounded by two oceans, and the extensive area of continental shelf known as the Agulhas Bank, which is a probable centre of adaptive radiation (Millard 1978, fig. 1); and (2) the convergence of oceanic waters of divergent temperatures and origins in the vicinity of the Cape Peninsula, via the colder Benguela Current of the South Atlantic and the warmer Agulhas Current of tropical Indian Ocean influence (Branch & Branch 1981: 14).

A zoogeographical analysis of the southern African octocoral fauna will be dealt with in a subsequent paper.

AFFINITIES OF THE FAUNA

Shallow-water benthic invertebrates of southern Africa are generally recognized to have four major zoogeographical components: temperate Atlantic, Subantarctic, Indo-Pacific, and endemic (Millard 1978; Gosliner 1987). Many deep-water species have more scattered or cosmopolitan distributions. Several species of the west and south coasts, such as *Lituaria valenciennes*, extend further north into the Mediterranean Sea. Similarly, a number of species of the east coast, such as *Calibelemnon indicum*, have wider distributions in the tropical Indo-Pacific. At least 20 species of hydroids from southern Africa have Antarctic or Subantarctic affinities (Millard 1978: 171–172). Gosliner (1987), in considering the sister relationships in opisthobranch molluscs, regarded the Subantarctic influence as perhaps the oldest influence, which may be associated with the break-up of Gondwanaland. In regard to sea pens, the cosmopolitan *Umbellula lindahli* is known from throughout Antarctic waters (Grasshoff 1982*a*: 753, map 11). However, no truly Subantarctic component is presently recognized within the southern African fauna. Endemic species, such as *Virgularia schultzei* and *Actinoptilum molle*, are found throughout the region, with the centre of distribution along the south coast (the region between the Cape Peninsula and the Transkei coast).

SUMMARY AND CONCLUSION

The present study is the first in a two part series of a comprehensive survey of pennatulaceans from the subcontinent of southern Africa. It has increased in the number of identified species in the region from 12 to 23, the number of genera from 10 to 20, and the number of families from 8 to 12.

The families recorded from southern Africa for the first time are the Kophobelemnidae, Protoptilidae, Scleroptilidae, and Chunellidae. The eleven species newly recorded for the region are *Cavernularia elegans*, *Echinoptilum macintoshii*, *Echinoptilum echinatum*, *Kophobelemnon stelliferum*, *Distichoptilum gracile*, *Chunella gracillima*, *Amphiacme abyssorum*, *Umbellula lindahli*, *Scytaliopsis djiboutiensis*, *Halipteris africana*, and *Pennatula inflata*. The genera *Cavernulina*, *Sclerobelemnon*, and *Calibelemnon* are recorded for the first time from the region.

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